POWER

FEBRUARY
1946

GENERATION, TRANSMISSION AND APPLICATION OF ALL THE POWER SERVICES

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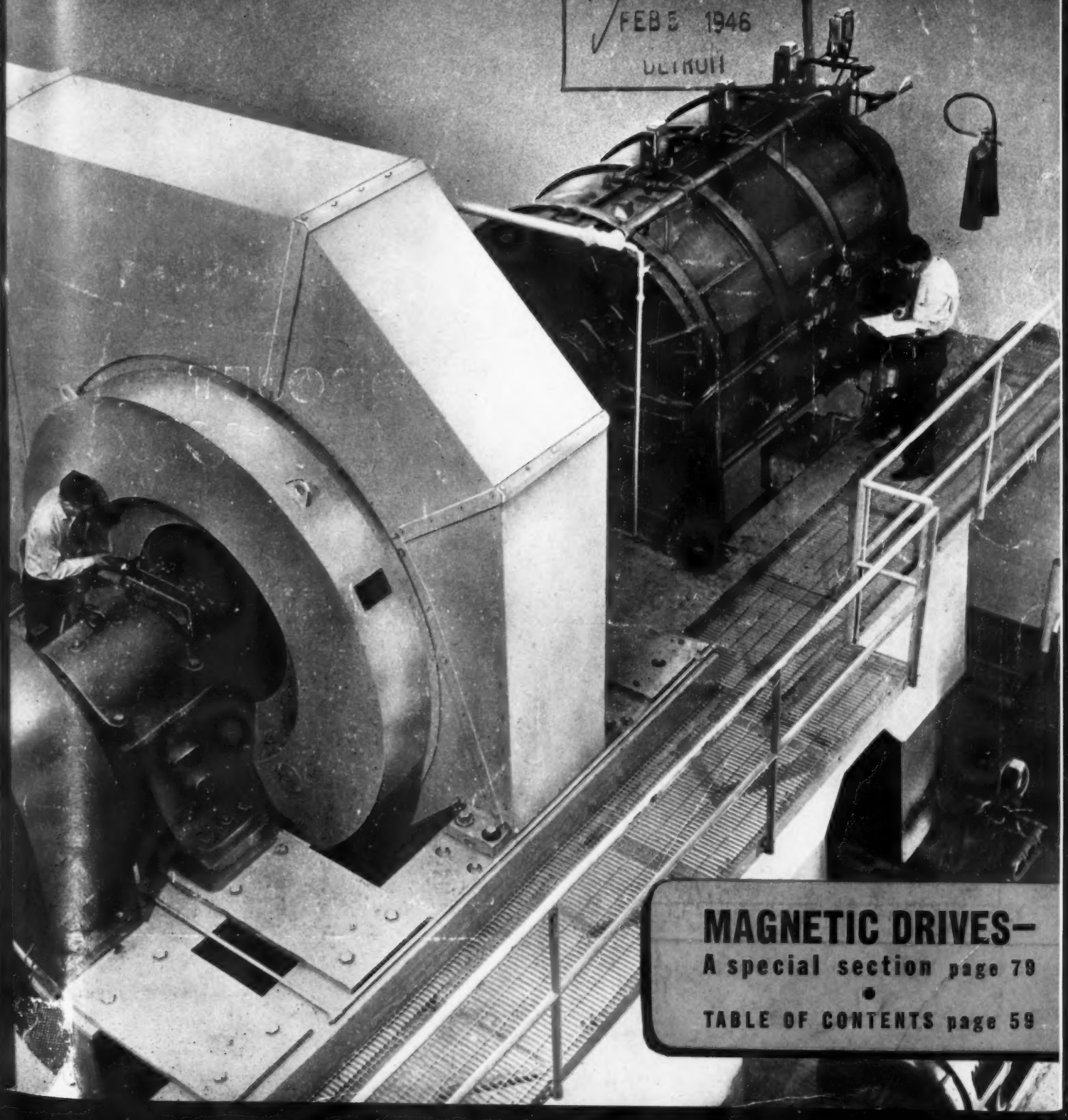
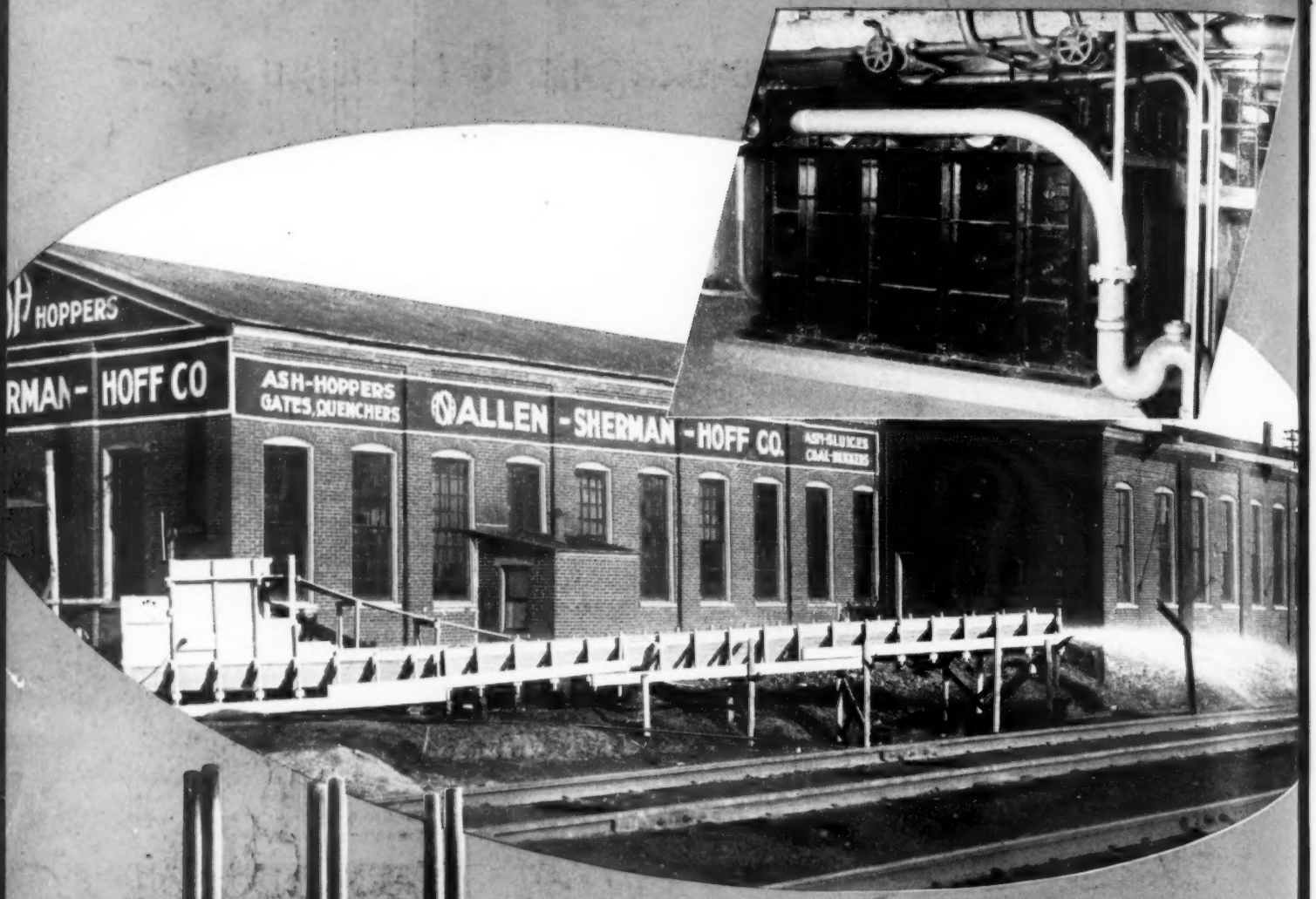
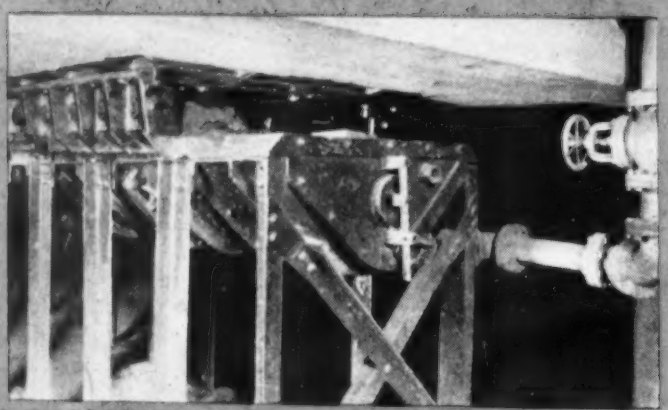


MAGNETIC DRIVES—
A special section page 79

TABLE OF CONTENTS page 59





HYDROJET *Pioneering*

The rapid increase in size of central stations in the middle 1920's made it obvious that the resultant huge daily ash tonnage could not be economically handled by dumping into cars or trucks. Something much faster was urgently needed, so with the co-operation of some of the leading engineers of those days, we pioneered the Hydrojet System. A picture of our experimental Hydrojet, built of wood and erected outside our plant, appears in the oval above. With this we learned some things about feeding ashes into the horizontal sluiceway, sluiceway design and water velocities. However, the ways of a pioneer are not easy. We had many headaches and heartaches, but with the assistance of our engineering friends, who on reading this will recognize this tribute to them, we succeeded in perfecting the Hydrojet. One of our first installations is pictured at the left. Note that the sluiceway then was V-shaped; now it is half round. A modern continuous slag tap Hydroseal is pictured in the upper right. Our catalog No. 6[illegible] shows the modern Hydrojet for every type of furna[illegible] and also shows what 20 years of pioneering have produce[illegible] in economy, speed and economy.

ALLEN-SHERMAN-HOFF CO., 227 S. 15th St., PHILADELPHIA 2, PA. ***Offices & Representatives in Principal Cities***

POWER (with which are consolidated "Science and Industry," "The Engineer Review," "The Engineer," and "The Stationary Engineer"), February, 1946, Vol. 90, N[illegible] monthly with an additional Directory number in December. McGraw-Hill Publishing Company, Inc. Publication office, 99-129 North Broadway, Albany 1, N. [illegible] Executive Offices, 330 West 42nd Street, New York 18, N. Y. Entered as second class matter, August 25, 1936, at Albany, N. Y., under the act of March 3 [illegible] in U. S. A. Allow at least ten days for change of address. All communications about subscriptions should be addressed to the Director of Circulation, Power, 3[illegible] Street, New York 18, N. Y. Please indicate position and company connection on all subscription orders. Subscription rates—U. S. and U. S. Possessions, $3.00 for [illegible] for two years. Canada, $3.50 for one year, $5.00 for two years. Great Britain and British Possessions, 36 shillings per year. All other countries, $6.00 for one [illegible] two years. Single copies 35 cents.

TECHNOLOGY DEPT:

How Conveyor-Mechanization *Cut Steam Costs for These Small and Moderate Size Plants*

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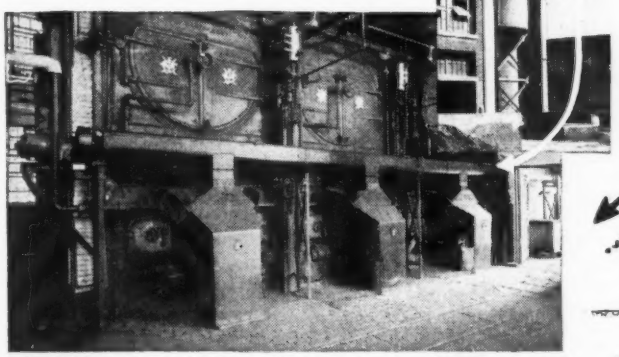
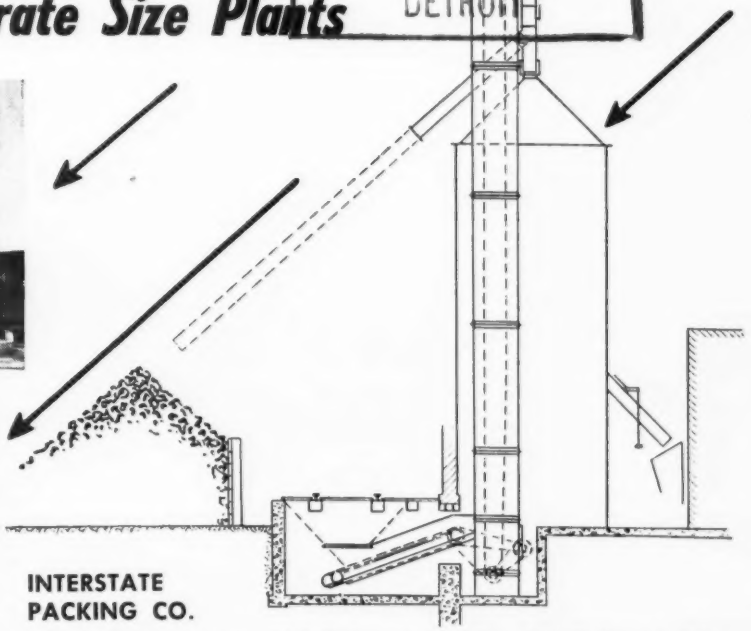
Below. Installed in limited space, this screw conveyor, bucket elevator combination not only solved a labor shortage problem, but cut handling costs and provided for additional fuel storage. Coal is discharged from trucks into a receiving hopper to a bucket elevator which delivers to storage bin. Horizontal screw conveyors supply the stoker hoppers of the three boilers from the storage bin.

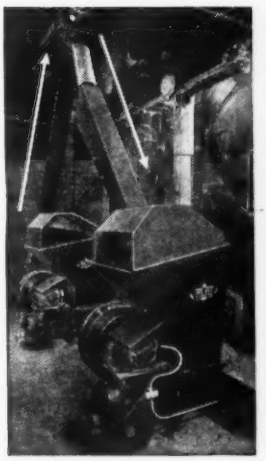




INTERSTATE PACKING CO.

This drawing shows a Link-Belt coal handling installation at this Wisconsin plant. It consists of track hopper, apron feeder, bucket elevator and storage bin. Coal is chuted direct from the bin to stoker hoppers with a detachable chute to outside storage. A simple and completely mechanized system that cut costs and increased efficiency.

Boiler room expansion with covered coal storage was accomplished at this plant without enlarging or raising roof of building or bunkers. Link-Belt elevator takes coal, delivered by truck, to silo with 20 ton live and 80 ton dead storage. Coal is spouted to boilers from this silo.



This ingenious, low-cost method of handling coal to the hoppers of two Link-Belt stokers from floor-level storage, utilizes an inclined Link-Belt screw conveyor with hinged discharge spout that permits coal delivery to either hopper as desired. This semi-automatic combination of screw conveyor and stokers is paying big dividends by cutting coal handling costs.

Vertical run of Link-Belt Bulk-Flo conveyor-elevator which delivers coal from storage pit outside boiler room wall to weigh larry. Slide gates in the wall lower the coal to the horizontal section of the Bulk-Flo. The vertical section delivers to a suspended weigh larry, equipped with chute, to hand-operated undercut gate, which regulates discharge to stoker hoppers. Bulk-Flo combines in a single unit, the functions of an elevator, a conveyor, and feeder with extreme flexibility of layout for coal and other flowable materials.

* * *

Whether your plant is large or small, and no matter what your conditions might be, there is suitable Link-Belt equipment to meet every requirement. Before you do anything else about it, talk over your problem with an experienced Link-Belt engineer. Send for Book No. 1510, "Solving the Problem of Coal and Ashes Handling."

LINK-BELT COMPANY

Chicago 8, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices in Principal Cities.

10,133

LINK BELT

COAL AND ASHES HANDLING EQUIPMENT

76 million lbs. of operating ...with B&W Integral Furnace Boilers

For high availability and continuity of service, for its rapid response to fluctuations in load demands, over-all economy and suitability for all types of fuels, the Babcock & Wilcox Integral-Furnace Boiler has won sweeping acceptance in hundreds of varied installations in almost every major industry. Since its introduction in 1933, B&W Integral-Furnace Boilers have been selling at the average rate of one every three working days! The total steam capacity of existing installations now exceeds 76 million pounds per hour. This outstanding acceptance of the B&W Integral-Furnace Boiler is due to the time-tested and performance-proved soundness, efficiency and flexibility of its design that embodies these features:

1. Furnace is entirely water-cooled, using types of construction similar to the practice in large central station boilers.
2. Deep furnace, fired from one end, provides ample space for complete combustion.
3. For gas and oil firing or for medium sized coal-fired units, this unit can be bottom-supported from the operating floor level, thus occupying a minimum of head room and requiring a minimum of structural steel.
4. The self-draining superheater adds to the convenience and saves time in starting up.
5. Tubes of the third bank, which is in the zone of coolest gases, act as downcomers, insuring rapid, positive circulation at all loads.

And the B&W Integral-Furnace Boiler is designed to burn pulverized coal, oil, or gas —alone or in combination. That means plants may utilize, at highest combustion efficiency, the least expensive commercial fuel available.

From their war-time proving under unprecedented operating conditions will come still better B&W Integral-Furnace Boilers to serve industry requirements for low-cost steam.

Now Used by: TEXTILE MILLS • FOOD PROCESSING PLANTS • CHEMICAL PLANTS • CENTRAL STATIONS • OIL REFINERIES • RAILROADS • INSTITUTIONS • PAPER MILLS • DISTILLERIES • GLASS WORKS • UTILITIES • CEMENT MILLS • SUGAR REFINERIES • AUTOMOTIVE PLANTS • STEEL MILLS • FOOD PLANTS • SCHOOLS

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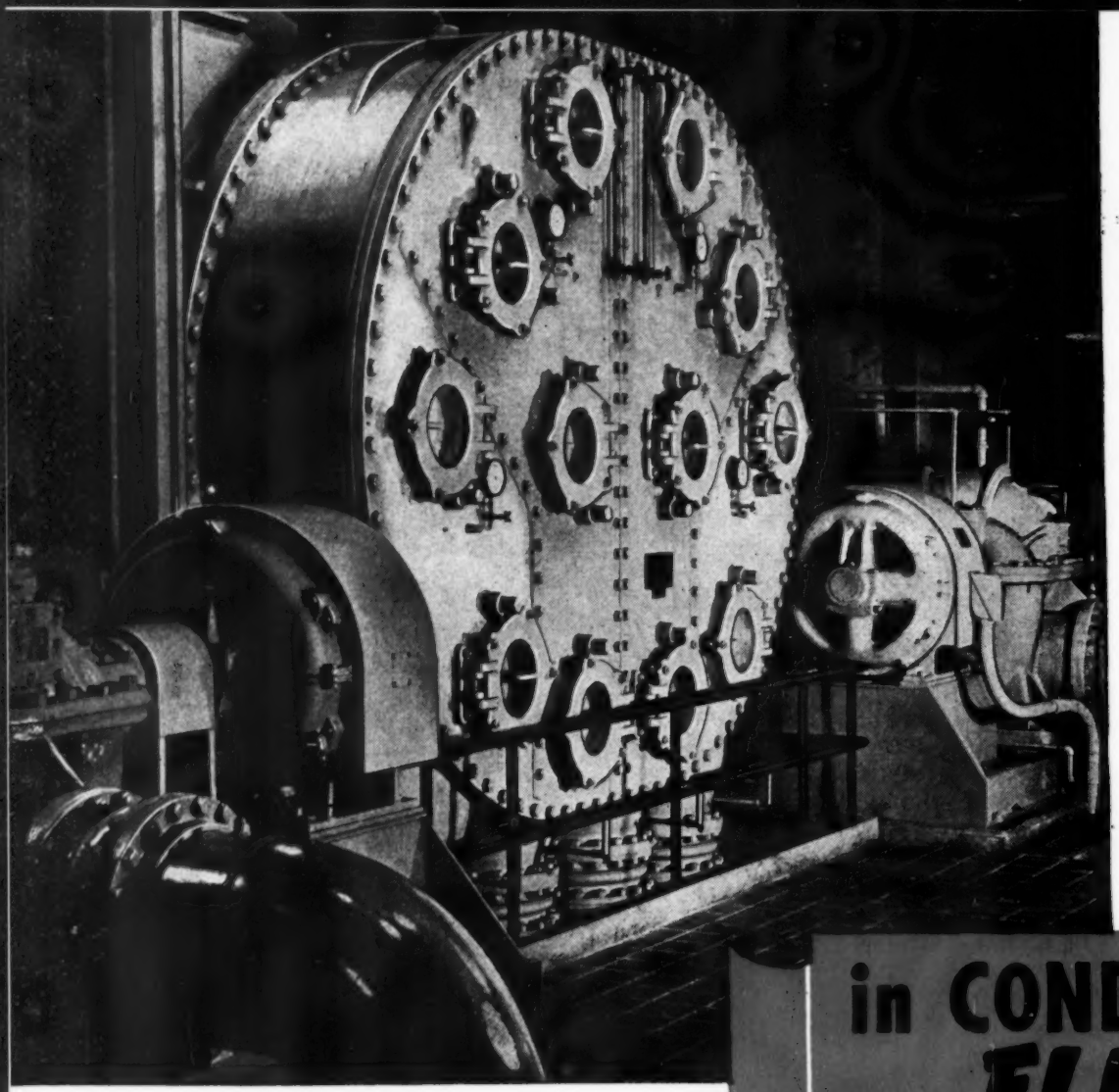


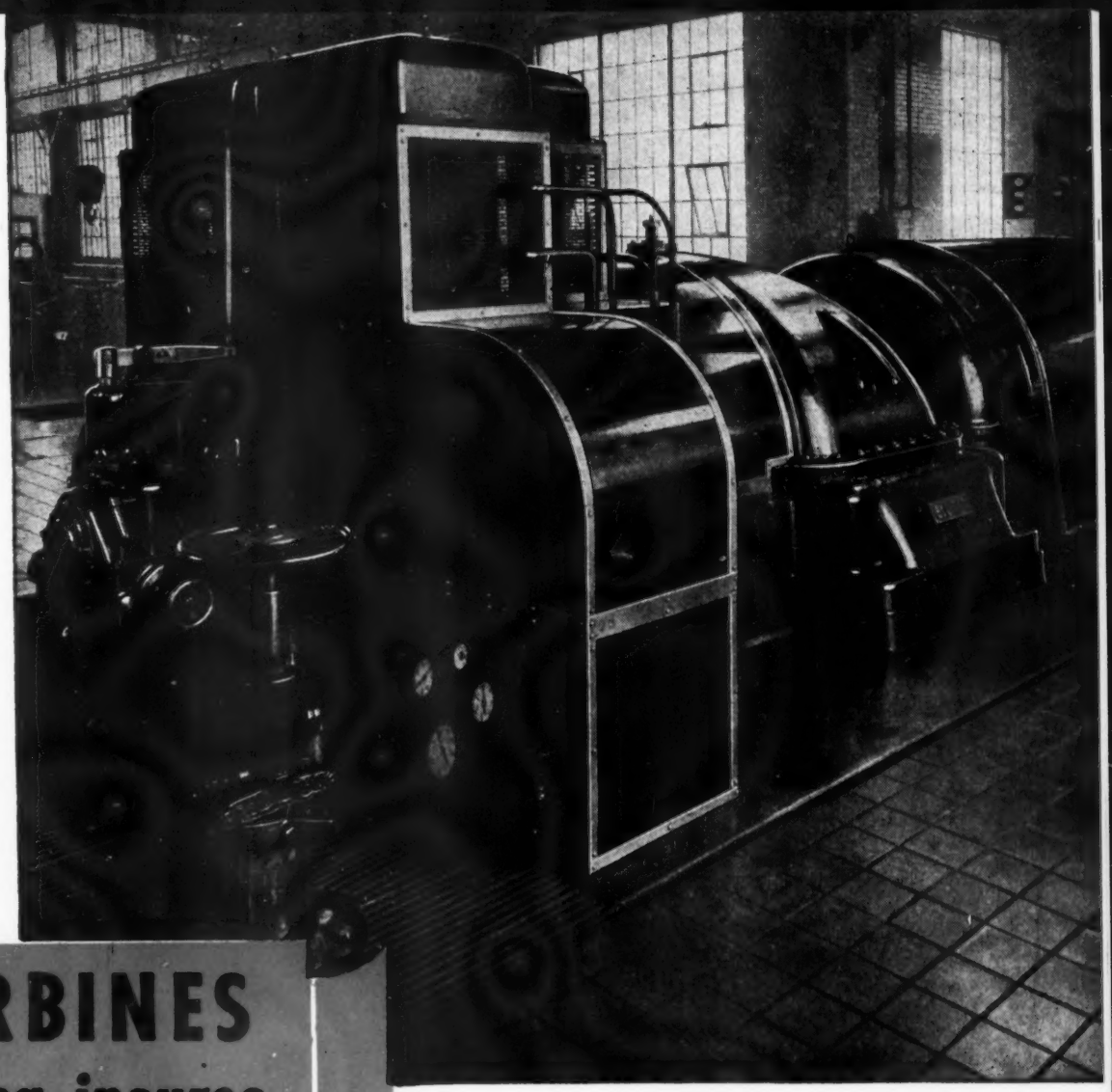
Elliott 27,000-sq. ft. surface condenser.

in CONDENSERS ... ELLIOTT outstanding

The many factors upon which condenser efficiency depends have been for years the subject of research by Elliott engineers. The arrangement and spacing of tubes to insure maximum contact with incoming steam, regulation of steam velocity, and maximum steam penetration; placing of tube supports to provide complete longitudinal steam distribution with minimum pressure drop; water collecting plates to prevent blanketing of tubes in the lower half of the condenser. And all other details to insure maximum condensing effect at lowest pumping and auxiliary costs.

Elliott condensers are "tailor-made" for the installations they serve. Their sound performance is amply demonstrated in many plants.

ELLIOTT



Elliott 6,000-kw turbine-generator unit.

in TURBINES engineering insures performance

The development of today's Elliott turbines is the reward of over forty years of intensive effort. It has been a case of "making haste slowly"—of avoiding revolutionary or extreme developments, of adopting improvements only after conclusive test—while at the same time never ceasing the effort for better turbine performance. This has involved constant modifications in workmanship as well as in design, the setting up of new, closer accuracy standards, of new, finer inspection procedure. And the working together of design engineers and shop staff with a single aim—to build a turbine better, if possible, than was ever built before.

When you need turbines—either as units with their generators, or for mechanical drive—talk it over with Elliott engineers.

Q-1116

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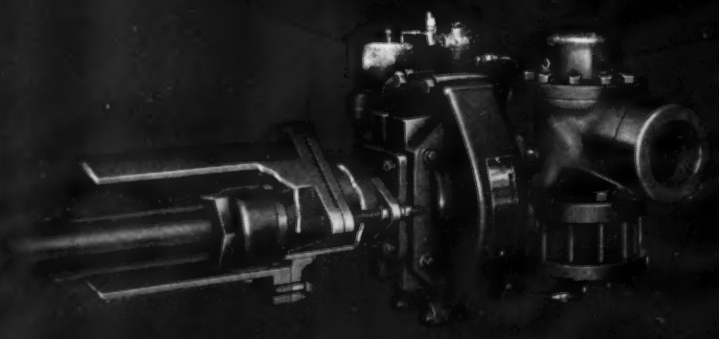
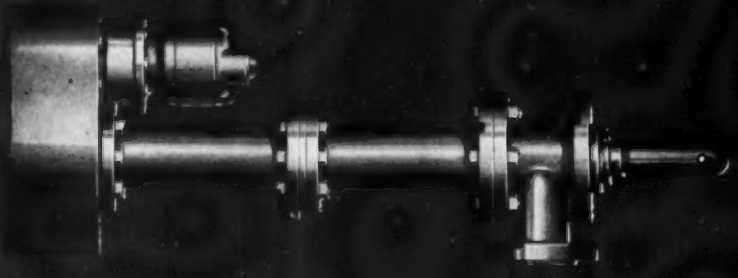
CLEANER BOILERS

With DIAMOND *Automatic Sequential* AIR SOOT BLOWERS



Diamond "Air Puff" Soot Blower having element permanently installed inside flue setting. Compressed air is discharged in a series of short puffs with substantial pauses between. Spreading cleaning cycle over longer period of time permits use of much smaller compressor and eliminates stack discharge nuisance.



Diamond Model IF Short Retracting Soot Blower for cleaning either furnace walls or boiler heating surfaces (by change in nozzle design) where gas temperatures exceed the limit for units permanently installed inside the setting.

DIAMOND POWER SPECIALTY CORP.

Detroit 31; Michigan

DIAMOND SPECIALTY LTD. • Windsor, Ontario

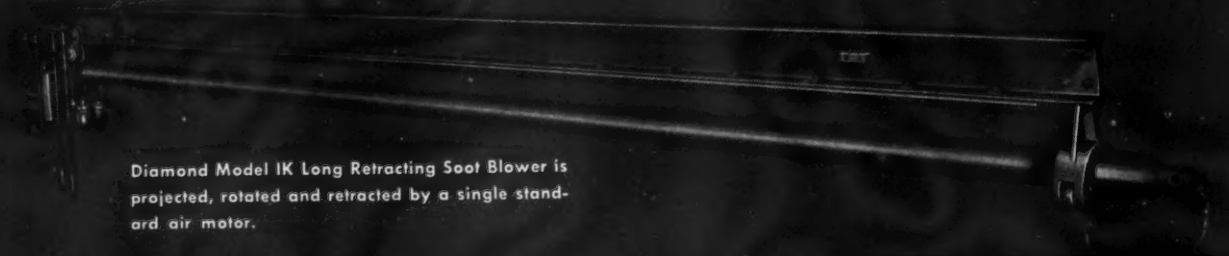
AT LOWER SOOT BLOWING COSTS

When the "Start" control of a Diamond Automatic Sequential Air Soot Blower System is pushed, the program panel takes over. Each blower is operated at exactly the right blowing speed . . . and in the correct sequence. No blower can be skipped or given the quick "once over" which hand-operated blowers often get. Also, compressed air has a greater density than steam and therefore is a better cleaning medium. The combined result is much more effective boiler cleaning.

Automatic operation saves considerable labor cost because it entirely eliminates the need for an operator. Using compressed air makes an additional saving by eliminating feed water makeup. Five years' operating experience has proved maintenance costs are unusually low and that air cleaning uses only ⅓ to ⅔ of the energy from the coal pile that is needed for steam blowing.

Automatic Sequential Air Soot Blower Systems of Diamond design and manufacture have been in successful operation on large central station boilers since 1940.

This program panel controls both fixed and retracting blowers arranged in three groups. Panel can be arranged for any number of groups when system is designed.

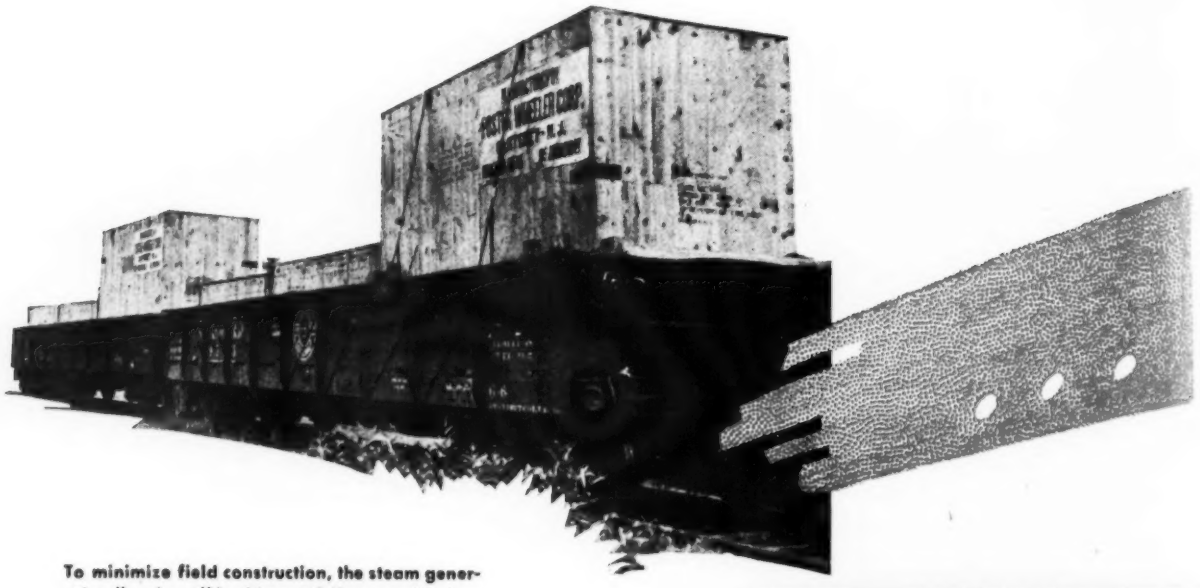


Diamond Model IK Long Retracting Soot Blower is projected, rotated and retracted by a single standard air motor.

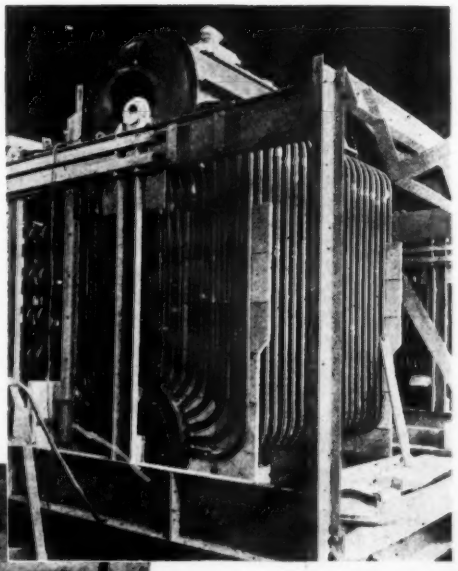
Diamond "Telescopic" Soot Blower is used where clear space outside the boiler is insufficient for the Model IK Blower. Electric drive shown but air drive also available.

AIR AS A CLEANING MEDIUM

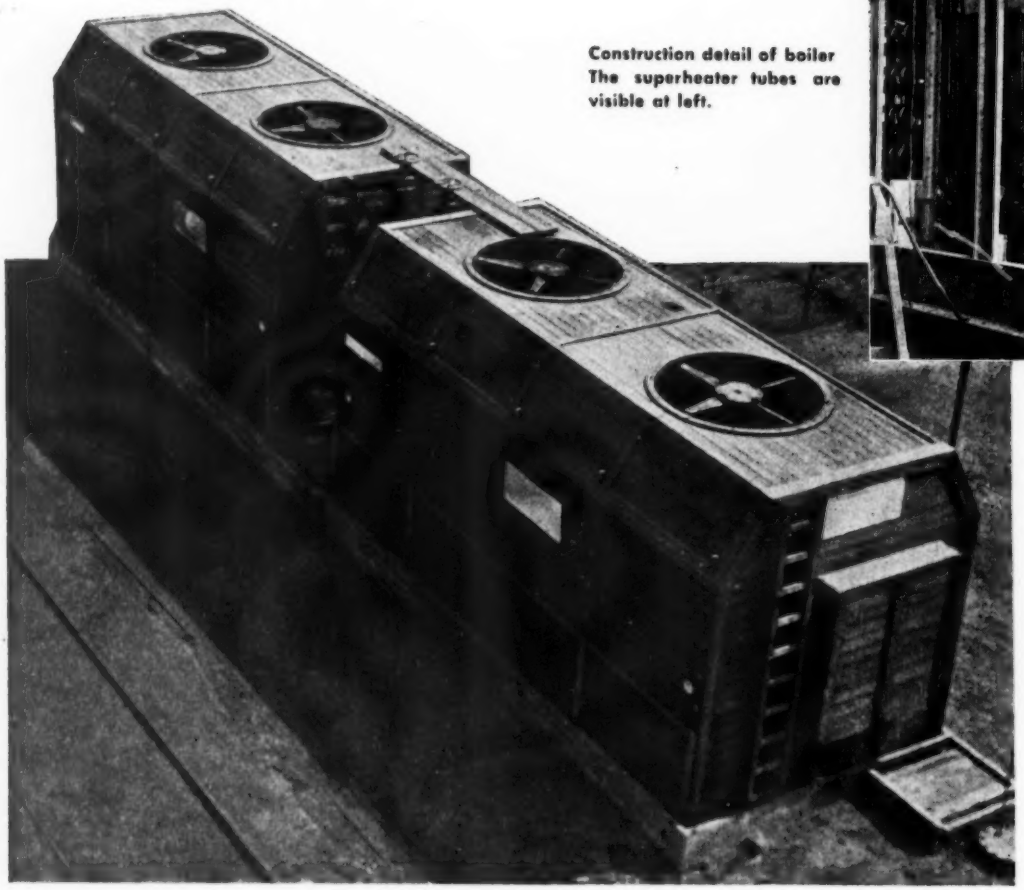
- SAVES FEED WATER MAKEUP
- SAVES LABOR
- SAVES MAINTENANCE
- SAVES FUEL
- SAVES PIPING INSULATION



To minimize field construction, the steam generating "package" is shipped fully assembled on a single railroad car.



Construction detail of boiler
The superheater tubes are visible at left.



Four-cell induced draft Foster Wheeler cooling towers, component equipment for package power plants. These towers are designed to cool 950 GPM from 105° to 91°

FOSTER

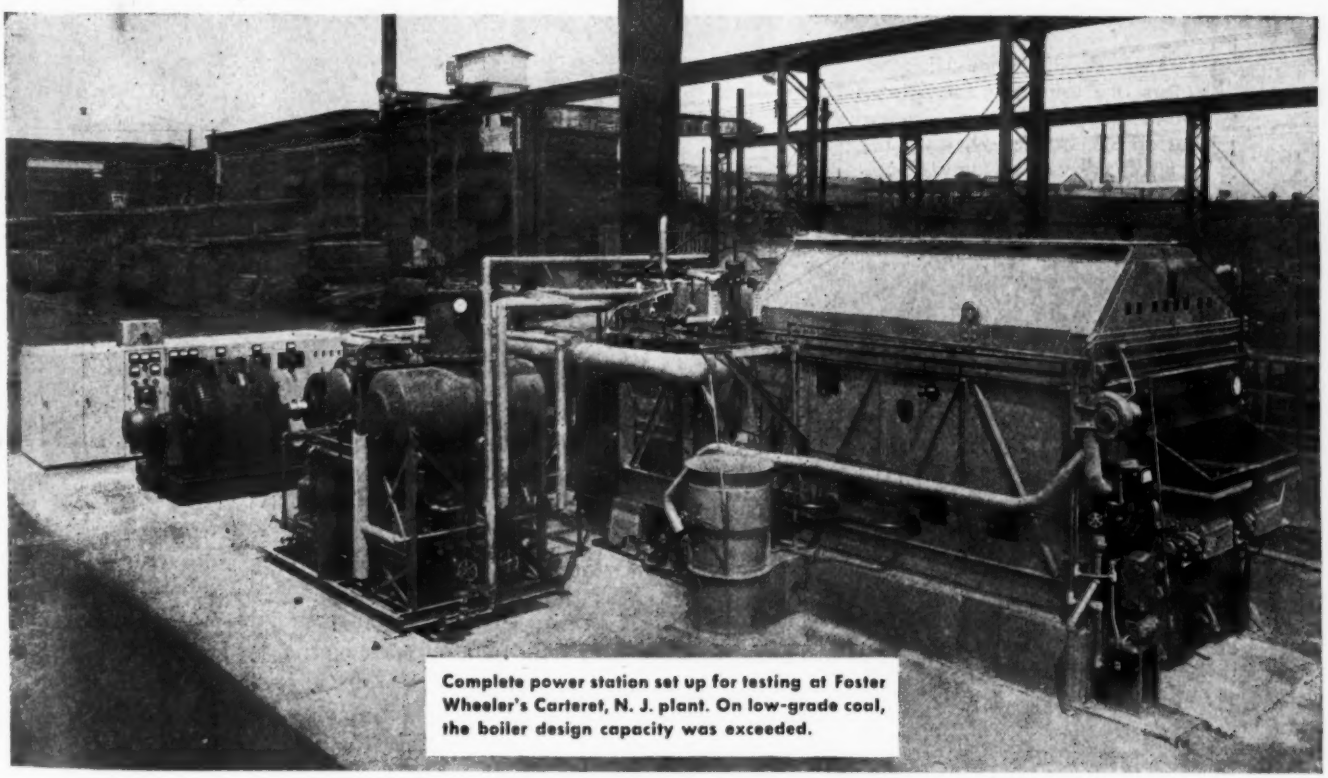
Boilers for PACKAGE POWER PLANTS

Two new concepts in steam-electric power generation—"package" and "unit" power—are today aiding rehabilitation of war-devastated areas in Europe and Asia. Hundreds of complete power stations have been supplied in types varying from field-assembled units to those shop-assembled and then shipped in a minimum number of "packages." Foster Wheeler has designed and constructed boilers for both types.

For the 1000 KW "package" type, designed by Peter F. Loftus, consulting engineer of Pittsburgh, Pa., Foster Wheeler has supplied 56 complete steam generating units. The unit includes boiler, furnace, superheater and economizer, assembled in an all-steel casing.

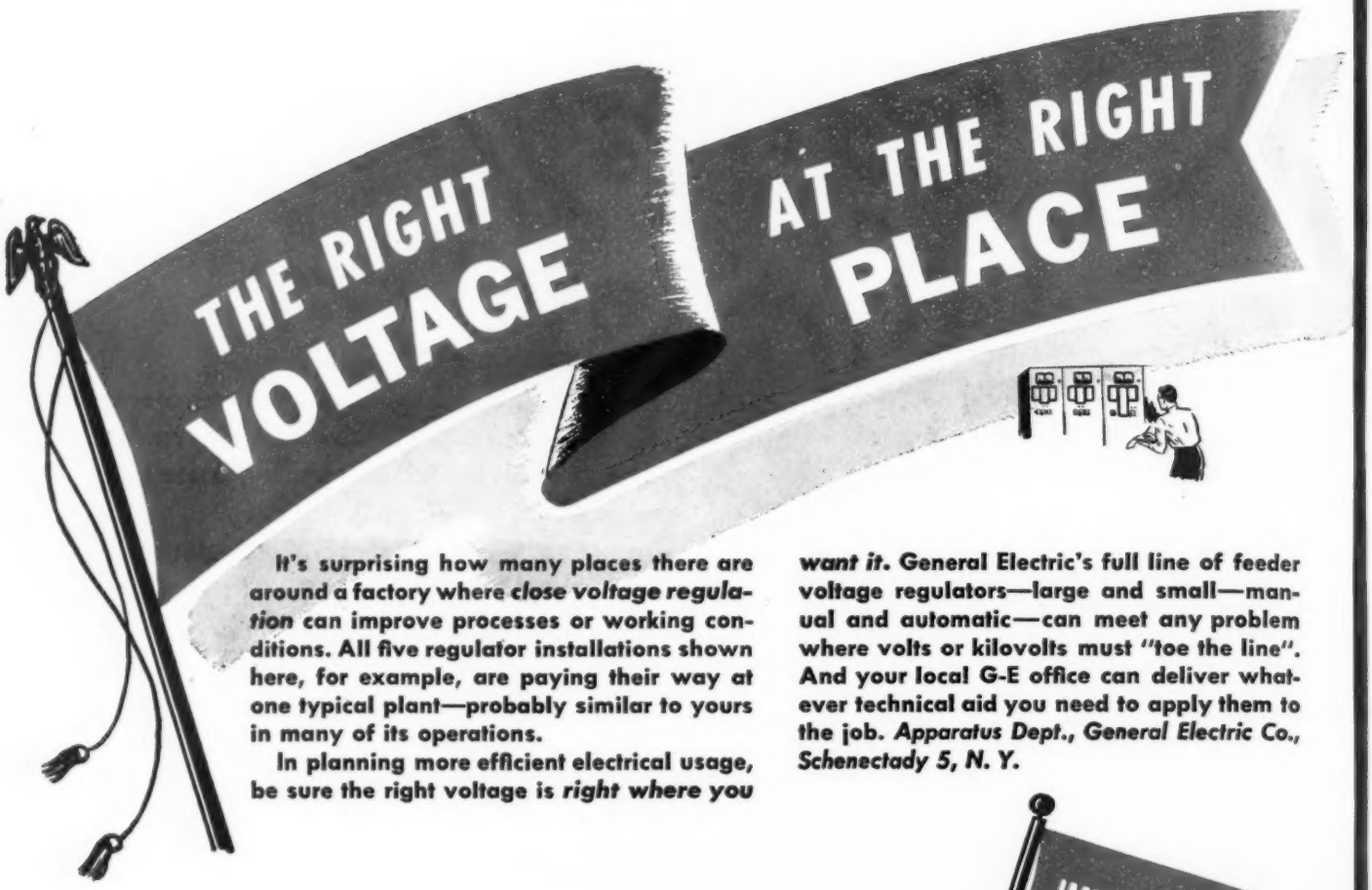
The boilers supply 16,000 lb. steam per hr at 405 psi and 750°F. final steam temperature. Low-grade coal, or peat, is fired on a dumper-grate type spreader stoker. The furnace may also be arranged to burn logs when no other fuel is available.

FOSTER WHEELER CORPORATION
165 Broadway, New York 6, N. Y.



Complete power station set up for testing at Foster Wheeler's Carteret, N. J. plant. On low-grade coal, the boiler design capacity was exceeded.

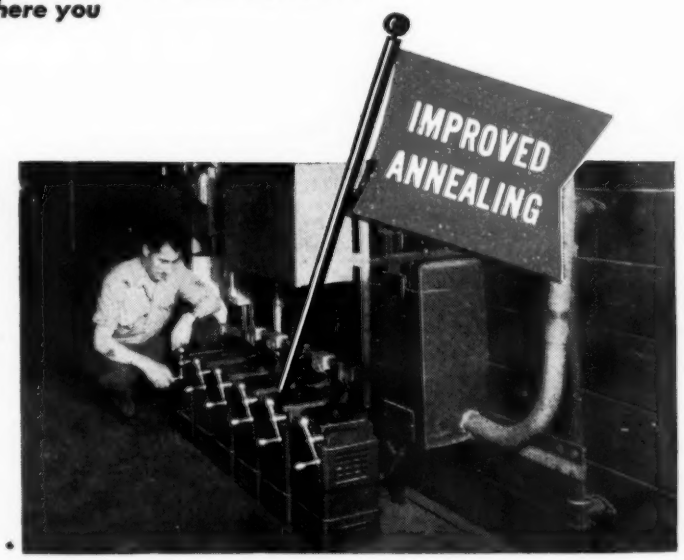
WHEELER FW



It's surprising how many places there are around a factory where *close voltage regulation* can improve processes or working conditions. All five regulator installations shown here, for example, are paying their way at one typical plant—probably similar to yours in many of its operations.

In planning more efficient electrical usage, be sure the right voltage is *right where you want it*. General Electric's full line of feeder voltage regulators—large and small—manual and automatic—can meet any problem where volts or kilovolts must "toe the line". And your local G-E office can deliver whatever technical aid you need to apply them to the job. *Apparatus Dept., General Electric Co., Schenectady 5, N. Y.*

1 These dry-type induction voltage regulators are used to control temperature of a wire-annealing operation. Twelve strands are processed simultaneously, each regulator acting to control the current-flow through series-connected sections of two conductors. These hand-operated regulators make it easy to adjust for different conductor sizes and other changes in operating conditions.

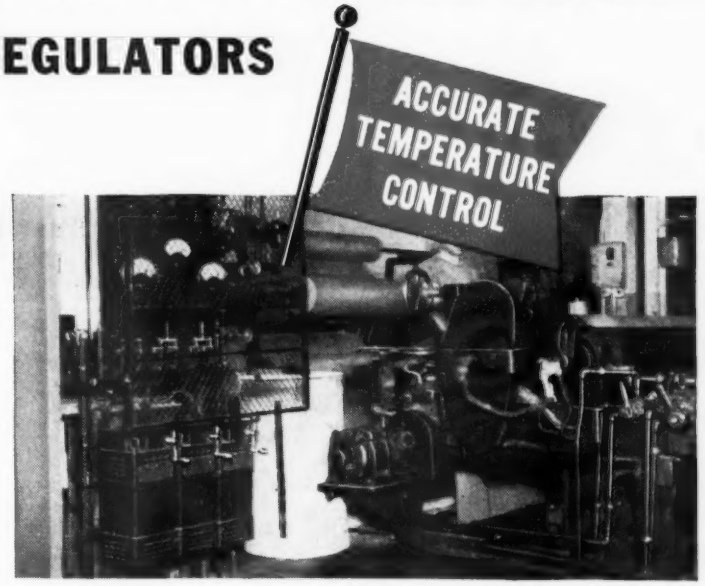


2 Smooth, stepless voltage control for 100,000-volt testing equipment is provided by this 5-kva dry-type induction voltage regulator. Connected in the primary (low-voltage) side of the step-up transformer, this regulator affords 100 per cent raise-and-lower regulation, so that output test voltage can be varied from 0 to 100 kv, simply by turning the crank.

...PAYS OFF 5 WAYS AT A SINGLE PLANT

USING G-E VOLTAGE REGULATORS

3 Electric heating circuits on a hot-rolling press used to fabricate laminated plastic forms are maintained at the required temperature with induction voltage regulators. Circuits for two electrically heated rollers and one hot plate are separately controlled by the hand-operated regulators, giving close control of processing.



4 Automatic voltage regulation by means of this dry-type induction regulator has "paid off" in a more uniform level of illumination. The full visual value of every kw-hr is obtained with fewer lamp burn-outs from overvoltage. Production space is saved by locating the regulator on a platform along with the Pyranol* transformer which serves the lighting circuits.

*Trade-mark for General Electric's nonsludging insulating and cooling liquid that will not burn

5 This 48-kva Pyranol induction voltage regulator, installed in a basement substation, automatically maintains the proper voltage for lighting circuits in the plant office building. A Pyranol regulator was chosen for its safety in this confined indoor location.

For complete information on any of General Electric's voltage regulation equipment, write for the following publications:

Oil-immersed Induction Voltage Regulators—Type IRS
GEA-2018 (24 kva and smaller)
GEA-2985 (36 kva and larger)
Pyranol Induction Voltage Regulators—Type IRS, GEA-3443
Dry-type Induction Voltage Regulators—Type AIRS, GEA-3057
Inductrols (Small Dry-type Induction Voltage Regulators)
GEP-238
Automatic Voltage Stabilizers GEA-3634
Variable-voltage Autotransformers GEA-3635

GENERAL ELECTRIC

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Here are the benefits you get from

BAILEY CONTROLS

1. **Fuel Conservation without decrease in output.**
2. **Lower Cost Steam.**
3. **Increased Safety for Plant and Personnel.**
4. **Better Power Service.**

Bailey Controls for boilers make the important factors of steam plant operation work together to insure ideal performance.

In order that all of these factors may be regulated in harmony with each other and the load demand, Bailey Controls are carefully engineered to the requirements of the units which they serve.

Bailey engineering service starts with the selection of suitable metering and control equipment and continues through the design, construction, calibration, installation and final adjustment on the job. Bailey field engineers are stationed in over thirty industrial areas throughout the United States and Canada for the purpose of rendering prompt "on the spot" engineering service without undue traveling expense.

The Bailey engineer in your community has extensive experience at his command, which includes tests on thousands of boiler installations, covering a wide range of fuels, furnaces and fuel burning equipment. He is in a position to help you secure the many benefits resulting from intelligent use of correctly selected and properly applied boiler control.

Bailey Controls for boiler operation are described in Bulletin 15-C. Write for your copy to Bailey Meter Company, 1036 Ivanhoe Road, Cleveland 10, Ohio —in Canada to Bailey Meter Company Limited, Montreal.

FUEL CONVERSION

If it becomes desirable or necessary to convert to another fuel, Bailey Controls can be adjusted easily to insure optimum results from the new fuel.

G-26

BAILEY METER COMPANY

1036 IVANHOE ROAD • • • CLEVELAND 10, OHIO

Controls for Steam Plants

COMBUSTION • PRESSURE
FEED WATER • LIQUID LEVEL
TEMPERATURE • FEED PUMPS

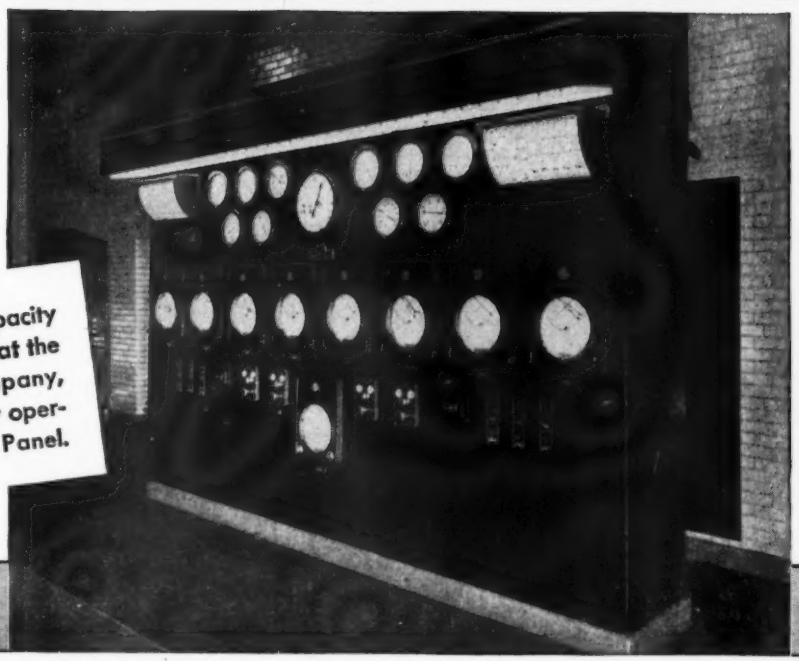
APPLICATION to STOKER FIRED BOILERS

UNDERFEED

This Bailey Control Panel insures optimum performance from three underfeed stokers on two 25,000 and one 40,000 lb. per hour capacity boilers at Parker Appliance Company, Cleveland, Ohio.

SPREADER

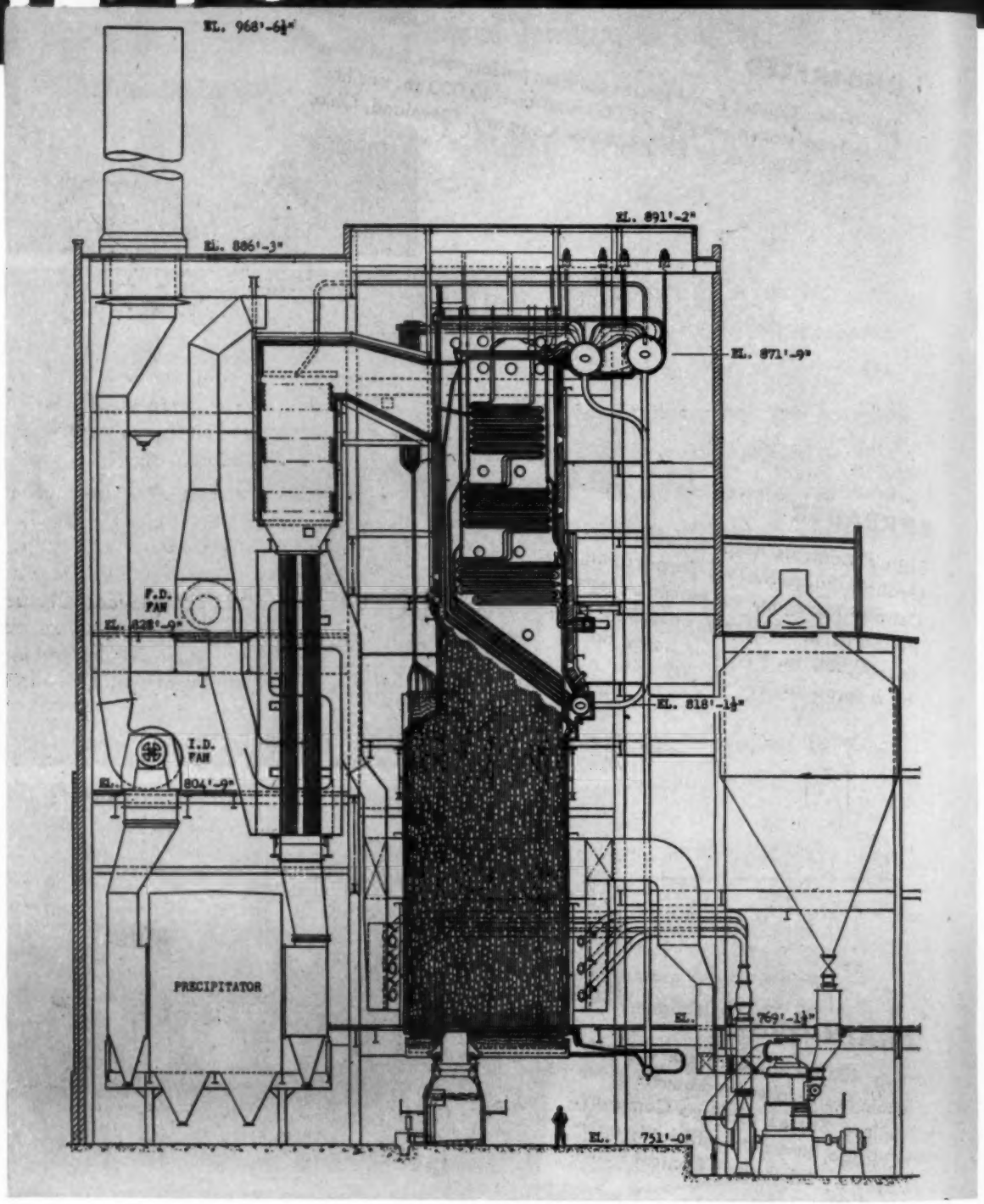
Bailey Controls help operators at Graham-Paige Motors Corporation, Detroit, Michigan, to maintain tests standards in everyday operation of this 60,000 lb. per hour boiler fired by a spreader type stoker.



CHAIN GRATE

Two 40,000 lb. per hour capacity chain grate stoker fired boilers at the United States Tobacco Company, Chicago, Illinois, are efficiently operated by this Bailey Control Panel.

THE POWER BEHIND



Section through one of the three large C-E high-pressure boilers in the Oak Ridge plant.

THE ATOMIC BOMB

WHATEVER the ultimate decision on divulging the know-how of atomic bomb production, it is no secret that enormous amounts of steam are required for both power and process.

C-E Steam Generating equipment predominated by a large margin in supplying the exceptional steam requirements. In the main plants engaged in atomic bomb production, a total of 33 C-E Boiler Units, having an aggregate capacity of 4,600,000 lb of steam per hr, were installed. In addition to these complete C-E Units, Combustion Engineering also furnished a number of stokers for firing boilers supplied by other manufacturers.

High Capacity C-E Units in Oak Ridge Plant

In the main power plant of the project at Oak Ridge, Tenn., three huge C-E Steam Generating Units supply steam for a number of turbine-generators. Each boiler unit has a rated capacity of 750,000 lb of steam per hr at 1325 psi and 935 F and has produced at higher outputs when required.

These C-E Boilers are of a special three-drum type, each equipped with a superheater, economizer and tubular type air preheater. The furnaces are completely water cooled and are tangentially fired with pulverized coal. A test run at an output of 724,000 lb of steam per hr showed an overall efficiency of 89.9 per cent, using coal of 11,505 Btu.

Delivery of Equipment in Record Time

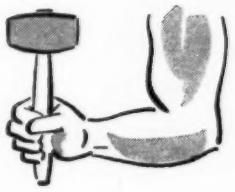
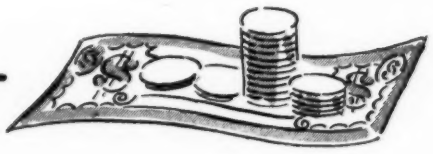
At a time when speed of production was of major importance, Combustion Engineering was able to place the first of these giant steam generating units in service at Oak Ridge only 10 months after the receipt of order.

A-933

COMBUSTION ENGINEERING

C-E

200 MADISON AVENUE • NEW YORK 16, N. Y.

Trade this  for this ; save and 

No more *forcing* of sheaves. Simple wrench operates Allis-Chalmers' "Magic-Grip" — *fastest mounting and demounting sheave on the market.* Saves time, money.

SEE HOW QUICKLY, EASILY THIS NEW SHEAVE MOUNTS AND DEMOUNTS

1 **Place sheave on shaft.** Slides on smoothly because clearance is provided by expanded bushing. There's *no* hammering — *no* forcing! Complete sheave and bushing unit comes intact—ready for quick, easy mounting.

2 **Align exactly,** using straightedge, (It's easy with this free-sliding sheave.) Then tighten three cap-screws; sheave is locked to shaft, *grips like magic!* No set screws to damage the shaft. Write A-C for Bulletin B6310.

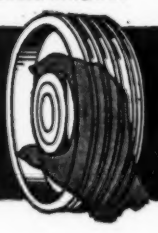
RECONVERTING?

GET THIS NEW FREE KIT!

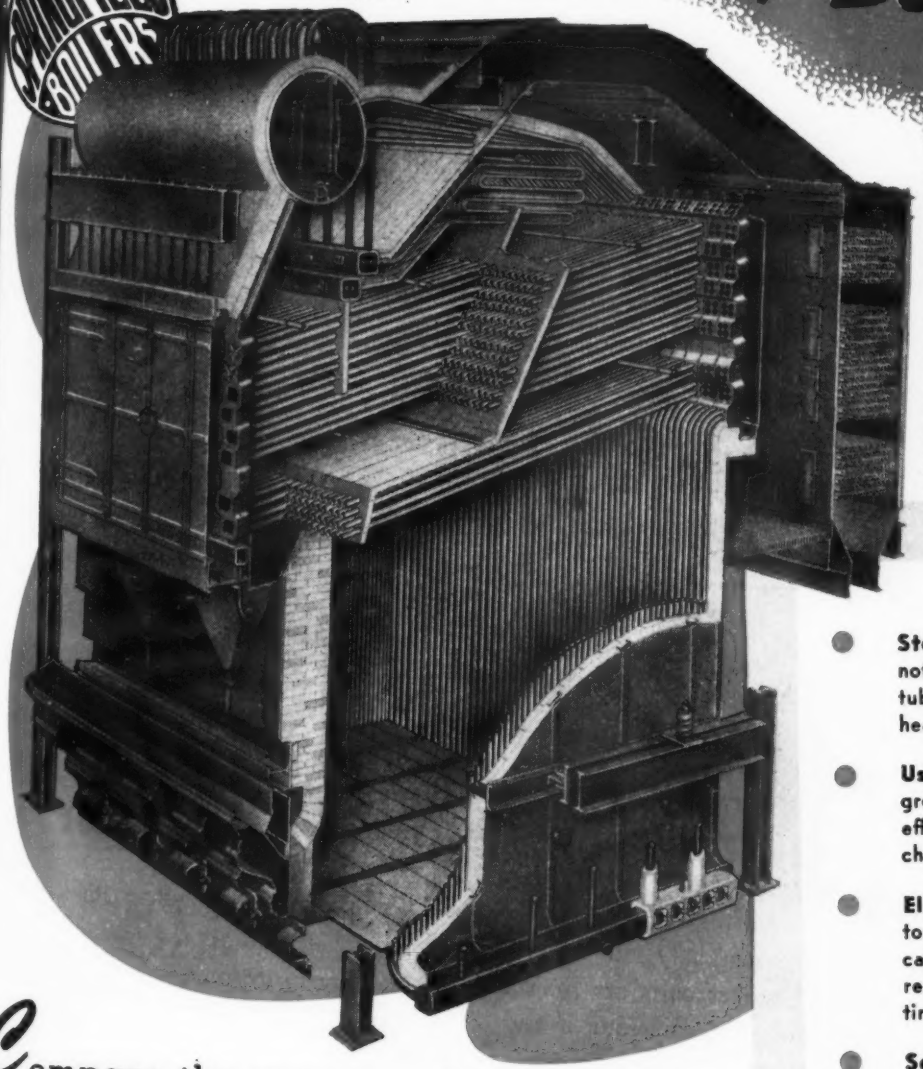
To help you find out how your present equipment will fit into future production, A-C offers a new free "Reconversion Inventory Kit" — Fact Sheets and Check Lists to speed your appraisal of V-belt drives, electric motors, and centrifugal pumps. Applies to all makes. Call your A-C distributor or district office, or write Dept. 31, ALLIS-CHALMERS MFG., Milwaukee 1, Wisconsin.

A 1855

Allis-Chalmers Texrope

"MAGIC-GRIP"  SHEAVES

Compare these Springfield PLUS VALUES



. . WITH THOSE OF ANY OTHER BOILER!

- **Staggered Tube Arrangement.** Hot gases cannot stratify or blow through without contacting the tubes. The staggered 4-tube grouping assures good heat transfer.
- **Use of Smaller Tubes.** Springfield's 3" tube groups break the water into more responsive, more efficient units. Result: Easier response to rapid load changes, higher heat transfer efficiency.
- **Electric Furnace Steel Headers.** Stronger, tougher Springfield headers of electric furnace cast steel mean more reliability, lower maintenance requirements, longer life, and saving in erection time.
- **Sectional One-Piece Baffles.** Prefabricated in the shop, with cross-tube baffles shop-assembled with the sections, Springfield baffles are permanently tight and long lasting. Result: Lower maintenance costs, saving in erection time, and higher operating efficiencies.
- **Close-Spaced Water Walls.** Adequate water cooling with bare tubes on close centers assures proper furnace temperatures, minimizes slagging, lowers maintenance and increases the reliability and life of the unit.

Compare the money and fuel saving features listed at the right with those of any other boiler. For complete information on all of Springfield's pioneering developments, and what they can mean to you in quick steaming, easy operation, low operating costs, and high efficiencies, write:

SPRINGFIELD BOILER COMPANY **1953 Capitol Avenue**
Springfield, Illinois

SPRINGFIELD BOILERS

SPRINGFIELD

STEAM GENERATING UNITS
ANY SIZE — ANY FUEL — ANY PRESSURE

FUEL BILLS CUT

WITH IRON FIREMAN PNEUMATIC SPREADER

JOHN BROWN
General Superintendent

Transo Envelope Company plant, 3542 N. Kimball Avenue, Chicago, Illinois.

Transo Envelope Company of Chicago switches to Iron Fireman firing and saves $8440 in 1 year

THREE Iron Fireman Pneumatic Spreader stokers replaced another type of automatic firing in the plant of the Transo Envelope Company in August, 1943. Since that time fuel bills have been cut almost in half—an annual saving of more than $8,000.

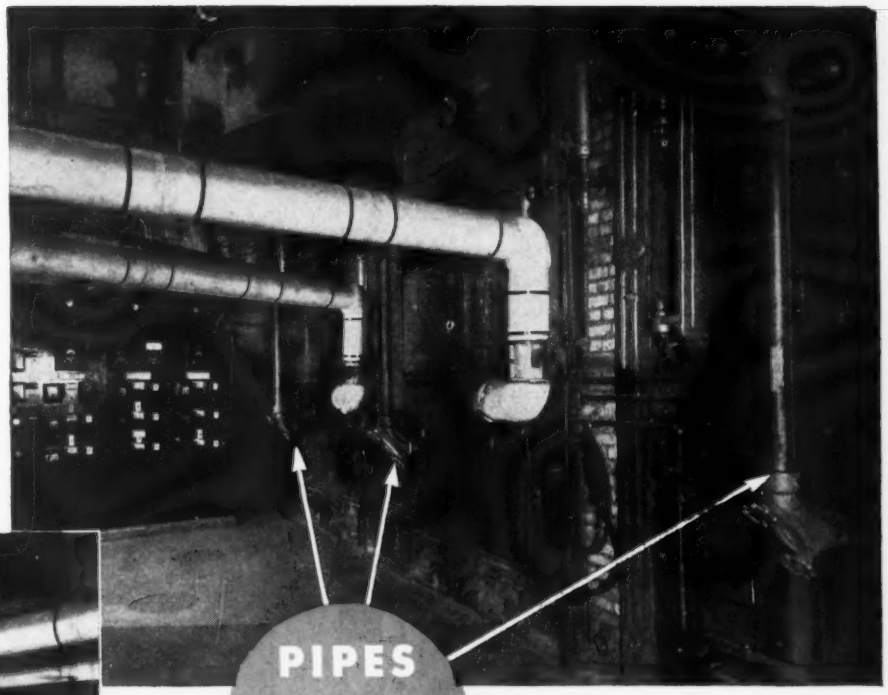
ADVANCED ENGINEERING. The extraordinary record of savings reported by Iron Fireman users is adequate evidence of sound engineering. Highly efficient combustion cuts coal tonnage. Maintenance costs have been remarkably low because no moving stoker parts are subject to high furnace temperatures and all mechanism is easily accessible. In addition to this, the rugged construction characteristic of all Iron Fireman products is plainly evident in the record of Iron Fireman stokers which have been in continuous service for as long as 20 years.

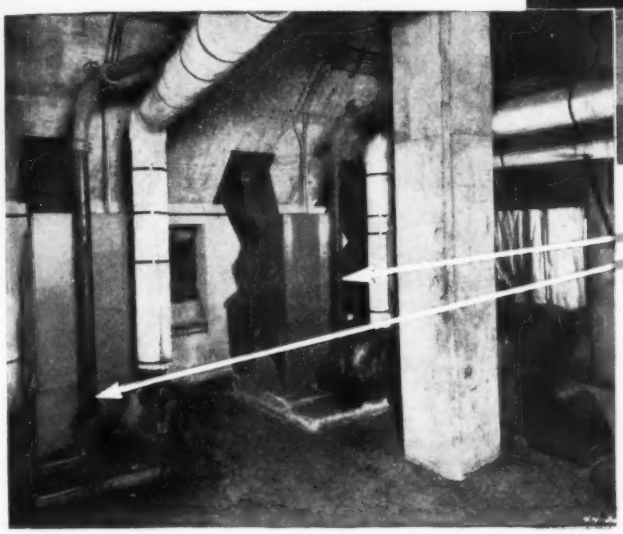
ADAPTABILITY. Because of its simple methods of firing and fuel conveying, the Iron Fireman Pneumatic Spreader has almost unlimited adaptability to existing boiler room layouts without costly remodeling.

FLEXIBILITY. The Iron Fireman Pneumatic Spreader has great flexibility of operation because it is highly responsive to fluctuating loads, and because it efficiently burns a wide range of coals, including the small sizes, the low ash fusion coals as well as sub-bituminous and lignite.

Heavy Duty Automatic Coal Stoker for Power Processing and Heating

48% STOKER

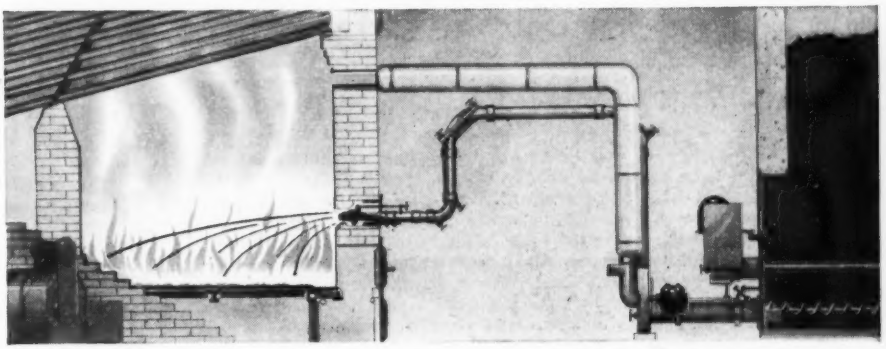




PIPES COAL TO FIRE

The accompanying pictures show Iron Fireman Pneumatic Spreader stokers in the boiler room of the Transo Envelope Company. Hot furnace gases carry coal to the boiler through the pipes indicated by arrows. Gases for this purpose are drawn from the combustion chambers through the heavily insulated pipes which are visible in both pictures. As can be readily seen, boiler fronts (above) are clear and readily accessible. At left are shown the coal hoppers which in this installation are fed from overhead bunkers. In other models the coal feeds directly from the main coal bunker or coal stock pile. Boilers can be served from bunkers or hoppers a considerable distance away, and even from different floor levels.

WHAT ABOUT YOUR BOILER ROOM? Are you sure your steam and labor costs are as low as they should be? Without cost or obligation you can have an accurate, impartial engineering survey of your boiler room. Write to Iron Fireman Manufacturing Company, 3269 W. 106th St., Cleveland 11, Ohio. Plants at Portland, Oregon; Cleveland, Ohio; Toronto, Canada. Dealers throughout the United States and Canada.

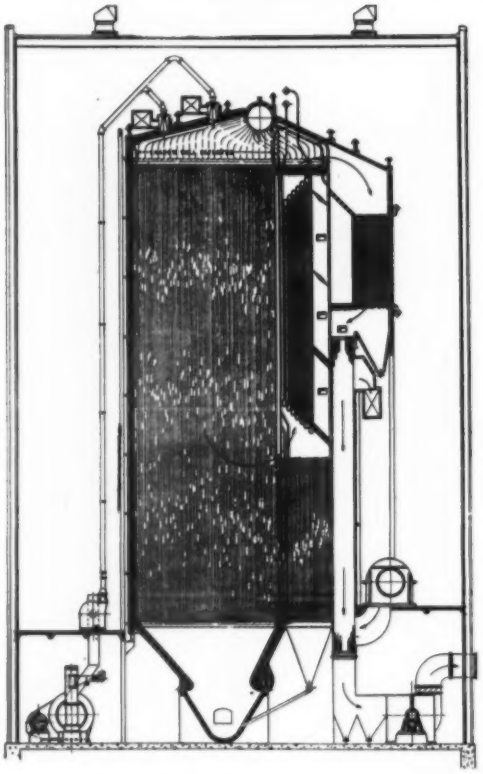


The Iron Fireman Pneumatic Spreader Stoker meters steam size coal from hopper or main coal bunker to transfer housing, where coal is picked up by pneumatic conveyor and delivered to furnace. The conveyor nozzle accurately spreads the larger particles of coal over the entire grate in a shallow, uniform fuel bed. The preheated fines burn in suspension, reducing the cinder carry-over and greatly improving the combustion efficiency and responsiveness, as compared with other stokers which do not preheat fuel.

IRON FIREMAN

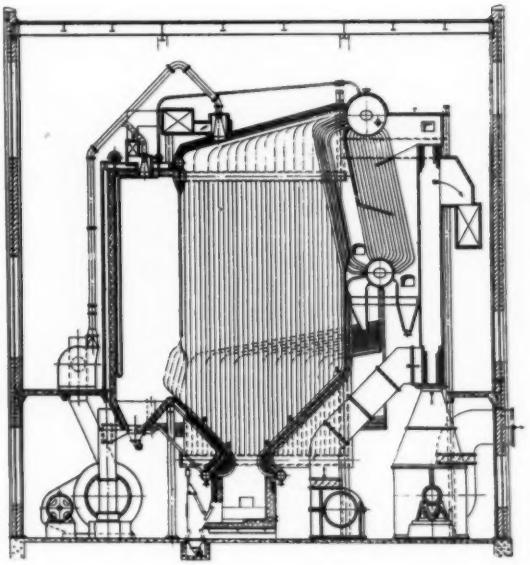
THE IRON FIREMAN

STEAM GENERATORS . . . .



SINGLE DRUM RADIANT BOILER

Side walls and end tubes are made up from tubes set one against the other and outside of wall made up of heavy tile and heat absorbing material. The second row of tubes is made up of patented shadow walls connected with the same headers that receive the tubes already described. Heat passes from initial furnace up through superheater and then down through economizer, thence down through preheater. Superheat is controlled by dampers placed in space between superheater and outside wall. All tubes are connected to four headers, assuring simple installation.



BOILER WITH SEPARATELY FIRED SUPERHEATER

This two-drum boiler is direct-connected to superheater at top, thereby restricting exhausted hot gases at the bottom. Accurate control of superheat at any steam flow is effected by varying the heat output of the burner which fires into furnace in which the superheater is located. Automatic regulation of fuel and air to burner makes possible the maintenance of uniform steam temperature over any load range or load fluctuation. Close control of the entire unit is maintained at all times.

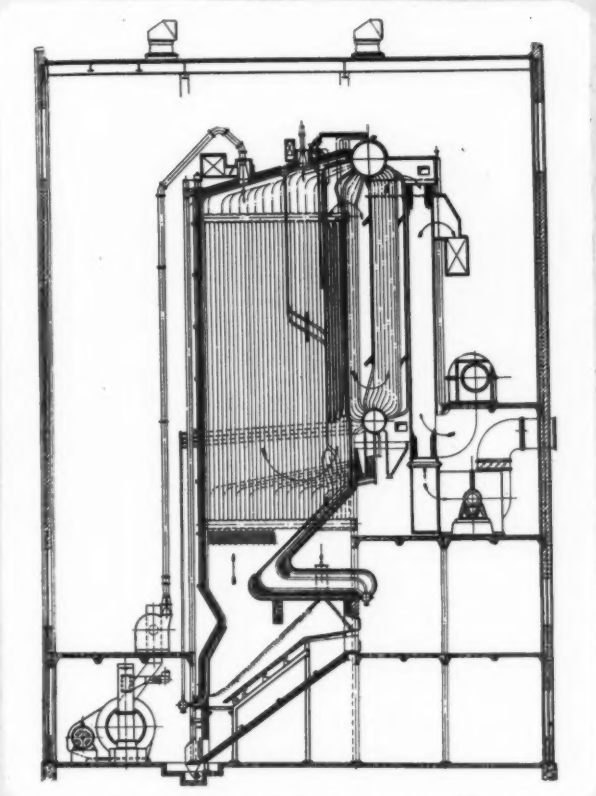
KVI BULLETIN 44-B

This 97-page, fully illustrated engineering bulletin is a handbook on modern steam generation practice. Kindly use your company letterhead in asking for your copy.

THE steam generators illustrated are typical examples of modern engineering practice as applied by KVS in boiler design. These units have been performance-proved, provide for operation on either bituminous or anthracite coals, and can be depended on for high efficiency and low operating costs.

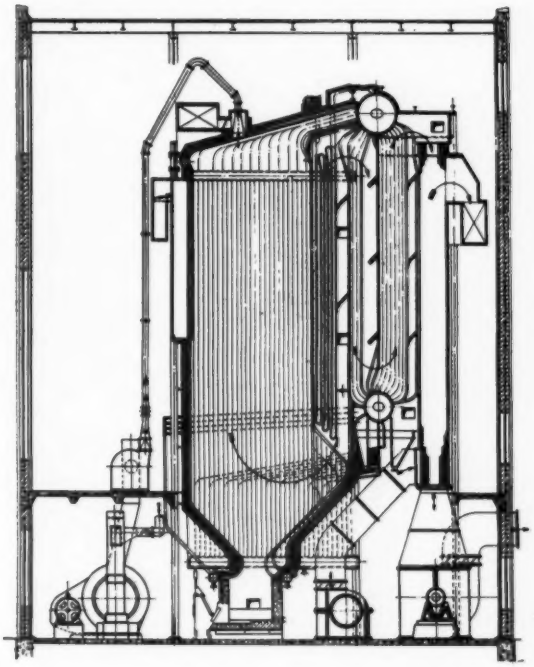
Designed, built and erected complete ready for operation by owner in a capacity range from 30,000# steam and up, to any pressure and temperature specifications. KVS assistance on your requirements is available under a single responsibility.

. . . designed by KVS for efficient operation on a FULL RANGE of COALS



BOILER FOR TWO KINDS OF FUEL

This two-drum boiler, with superheater and preheater, can be fired with anthracite or bituminous coal and any type coal used when ground in the KVS Air Swept Tube Mill because of the perfect pulverization assured. A feature of this boiler is that it is designed to burn hog fuel—chips, bark, waste, etc. —on the lower grates. Both the pulverized coal firing and the hog fuel firing are combined to operate either together or independently, as required, without interference one with the other.



CONVECTION BOILER FOR ALL FUELS

This KVS Steam Generator is designed especially for burning anthracite or low grade coal, thereby providing wide latitude in coal selection and making it possible to effect substantial savings in steam cost. Coal is fired at top and air passes down-through furnace and then up through superheater. Superheater chamber is equipped with dampers for controlling superheat. Gas then goes through several passes in boiler and thence into top of preheater. Note that gas flow is streamlined from furnace entrance to stack.

Kennedy Products — Kennedy-Van Saun Mfg. & Eng. Corp. — New York, U.S.A.

Kennedy-Van Saun

MANUFACTURING AND ENGINEERING CORPORATION

2 PARK AVENUE • NEW YORK 16, N. Y.

FACTORIES: DANVILLE, PA.

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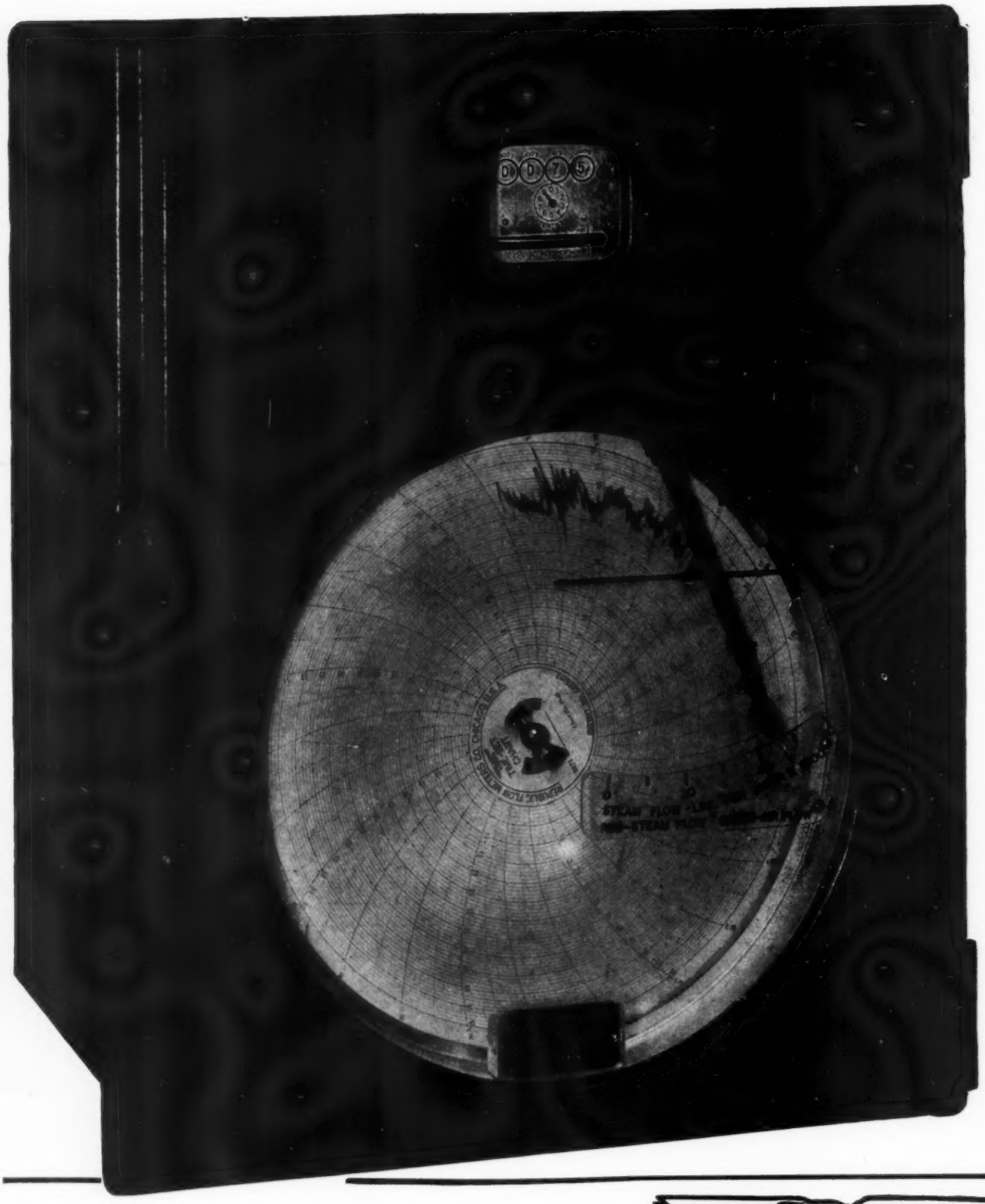
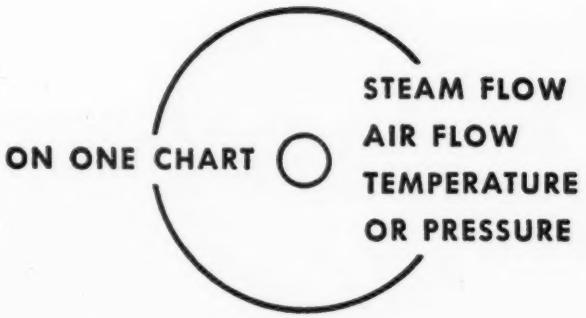
Write for Data on the



REPUBLIC
INSTRUMENTS
AND CONTROLS

Republic Boiler Meter



● The new Republic Boiler Meter provides, in one instrument and on one chart, all the essential information concerning boiler performance regardless of the size or type of boiler, kind of fuel or method of firing.

The meter indicates, records, and integrates steam flow from the boiler and records rate of air flow for combustion. When the correct amount of air for maximum combustion efficiency is being supplied the air flow pen will record coincident with the steam flow pen, regardless of the load being carried by the boiler.

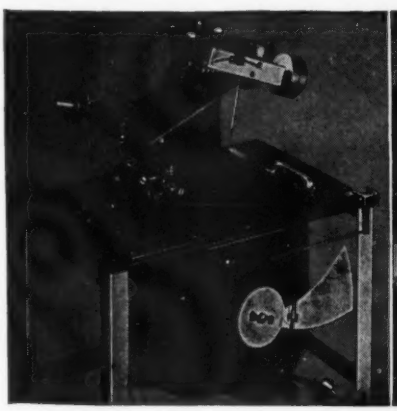
A third pen recording flue gas temperature (or steam pressure) can be added thereby providing the operator with complete information, on one 12-inch chart, relative to the performance of the boiler at any given time.

The Republic Boiler Meter is primarily a boiler operating guide. The two records, steam flow in red and relative air flow in blue, tell the operator instantly whether correct combustion and furnace conditions exist, thereby enabling him to correct faulty conditions when they occur.

The Republic Boiler Meter consists of a standard Republic electric steam flow recorder and integrator and an oil sealed, bell type air flow element.

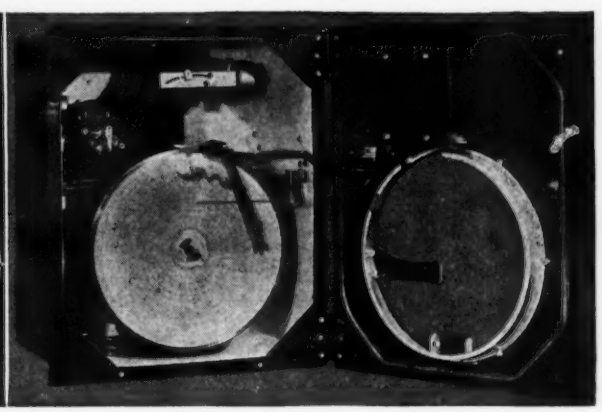
The air flow element consists of an oil sealed bell in a sealed chamber. The motion of the bell is transmitted through a diaphragm seal. This arrangement permits the use of a single bell—the high pressure being applied to the top of the bell and the low pressure under the bell. This arrangement also excludes air and dirt from the oil. The motion of the bell is transmitted to a cam system which extracts the square root, or when adjusted for a particular installation, compensates for chimney action and variable excess air requirements. The air flow pen is attached to the cam system with an adjustable linkage which permits changing the steam flow air flow ratio as conditions may require.

The entire operating mechanism is housed in a rugged steel case and can be easily removed as a single unit by merely loosening two anchor bolts and disconnecting the two air connections. The meter may be either wall mounted or flush mounted on a steel panel. *Write for Bulletin No. 420.*



Meter assembled as one unit on rack ready for calibration.

Meter assembly can be easily removed from the case.



Meter with door open showing accessibility of all adjustments and working parts.

Republic Flow Meters Co.

2222 Diversey Parkway • Chicago 47, Illinois

HIGH PRESSURE BOILERS

Triple

YARWAY UNIT TANDEM BLOW-OFF VALVES, built for pressures up to 2500 psi. Combining a Hard-Seat and a Seatless Valve in a single one-piece forged steel body, this Tandem provides the advantages of both designs—for blowing or for draining and sealing—in a compact, rugged unit.

Outside sealing valve is the famous Yarway Seatless design which has no seat to score, wear and leak. This valve is always opened first and closed last.

Inside (next to boiler) blowing valve is the Yarway Hard-Seat Valve which utilizes special alloys and unique construction features to reduce normal wear in this type of valve. Ask for Catalog B-432.

YARWAY STEAM PLANT EQUIPMENT

NEED THIS...

Protection

Modern Steam Generating Units represent big investments. They are worthy of the best auxiliary equipment available.

Power engineers have found it sound judgment to insist on Yarway Tandem Blow-Off Valves, Yarway Water Columns and Gages, and Yarway Remote Liquid Level Indicators . . . have learned through experience that these are the best protection for their major investment.

Sound design and careful attention to every mechanical and metallurgical detail are the reasons for Yarway performance and leadership. Nearly 40 years' experience with power plant problems—and constant research and development to keep abreast of Industry's requirements—justifies the slogan "Yarway-Equipped—A Mark of Good Engineering."

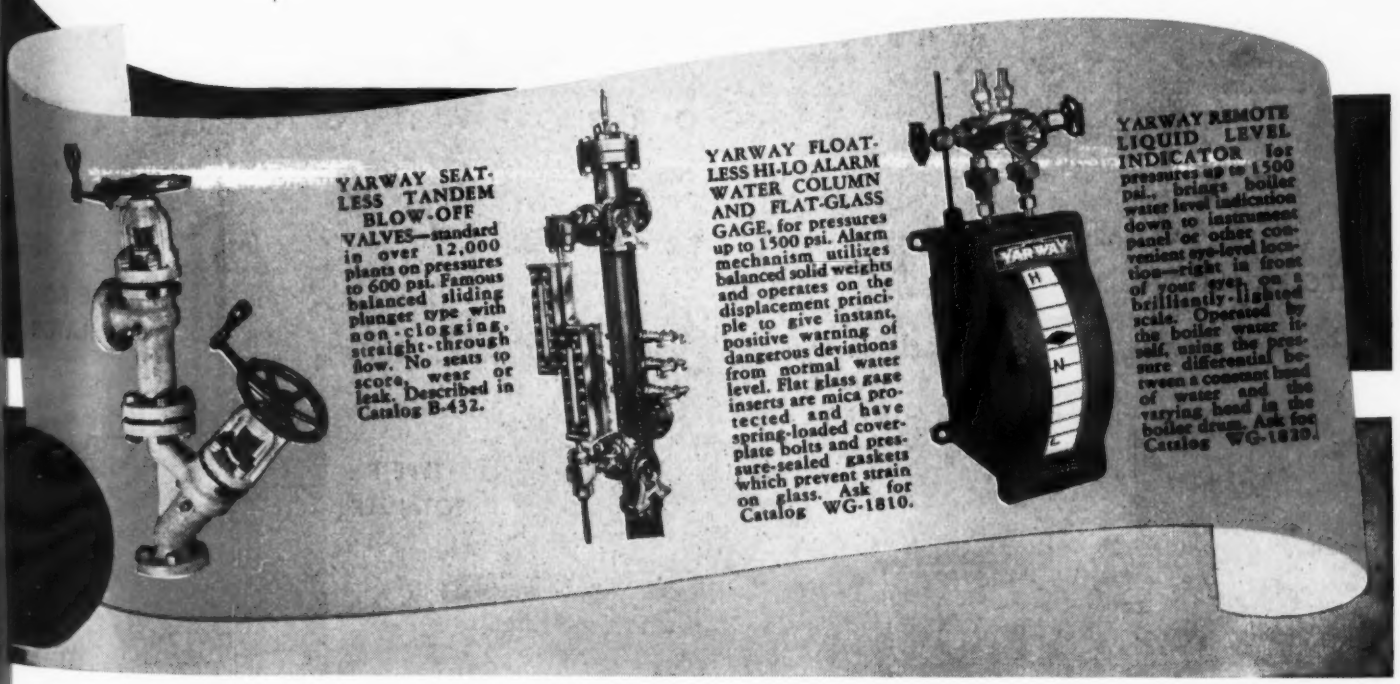
When adding new power equipment, or modernizing your present installation, remember to specify Yarway auxiliaries. Write for descriptive catalogs now.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.

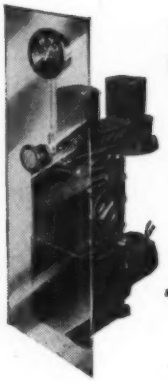
●

Blow-Off Valves, Water Columns and Gages, Liquid Level Indicators, Expansion Joints, Impulse Steam Traps, Strainers, Spray Nozzles.

Ask about the new Yarway 30-minute color and sound motion picture, available for group showings.

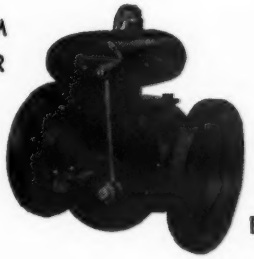

YARWAY SEATLESS TANDEM BLOW-OFF VALVES—standard in over 12,000 plants on pressures to 600 psi. Famous balanced sliding plunger type with non-clogging, straight-through flow. No seats to score, wear or leak. Described in Catalog B-432.
YARWAY FLOATLESS HI-LO ALARM WATER COLUMN AND FLAT-GLASS GAGE, for pressures up to 1500 psi. Alarm mechanism utilizes balanced solid weights and operates on the displacement principle to give instant, positive warning of dangerous deviations from normal water level. Flat glass gage inserts are mica protected and have spring-loaded cover-plate bolts and pressure-sealed gaskets which prevent strain on glass. Ask for Catalog WG-1810.
YARWAY
H
N
L
YARWAY REMOTE LIQUID LEVEL INDICATOR for pressures up to 1500 psi., brings boiler water level indication down to instrument panel or other convenient eye-level location—right in front of your eyes, on a brilliantly-lighted scale. Operated by the boiler water itself, using the pressure differential between a constant head of water and the varying head in the boiler drum. Ask for Catalog WG-1820.

STEAM SEPARATOR

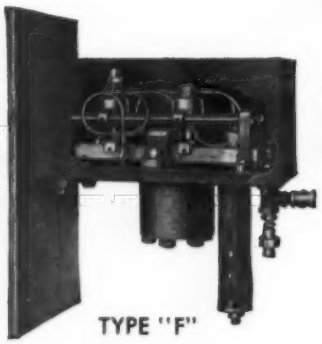


TYPE 2 SO REGULATOR

DIAPHRAGM REGULATOR



V PORT BUTTERFLY VALVE



TYPE "F" MASTER SENDER

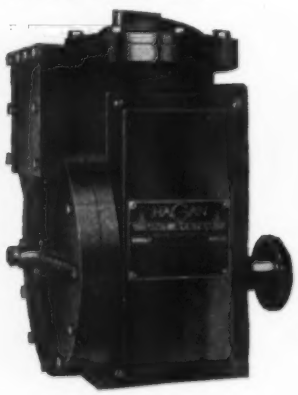
If you need equipment for any of these applications

RATIO RELAY

get in touch with HAGAN CORPORATION

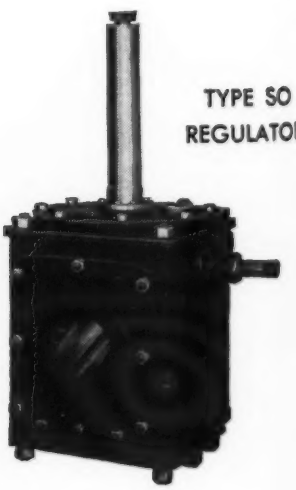
Hagan Building, Pittsburgh 30, Pa.

VARIABLE RATIO REGULATOR



RECEIVING REGULATOR

TYPE F TOTALIZER



TYPE SO REGULATOR

Combustion rate of boilers

Constant or graduated draft

Constant or graduated pressure (F.D.)

Feeder or stoker speeds

Flow of liquids

Control of multiple fuel firing

Fan speed control

Pump speed control

Hydraulic coupling control from speed or delivery of driven unit

Constant differential pressure (liquids or gases)

Constant differential draft (liquids or gases)

Graduated differentials (automatically or manually—liquids or gases)

Control of steam pressure

Control of pump discharge pressure

Control of pump discharge flow

Steam flow control

Steam pressure reduction

Steam temperature control (superheat)

Removal of oil and solids from exhaust steam

Removal of oil and moisture from compressed air

Steam desuperheating control

Separately fired superheaters

Flow of gases

Ratio control of gas flows

Ratio control of fuel and air (boilers)

Remote manual or automatic control

Flash tanks for recovery of steam from continuous blowdown systems

Program control for firing cycle

Oil burner control

Oil burner fuel-air ratio control

By-pass damper control for air preheater protection

Feed water heater pressure control

Feed water heater temperature control

Liquid level control

Control of multi-speed motor drives

Safety protection for gas or pulverized coal firing

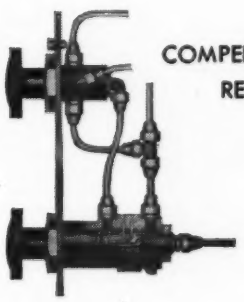
Steam jet refrigeration control

Removal of excess moisture and solids from saturated steam

Force measurement and control

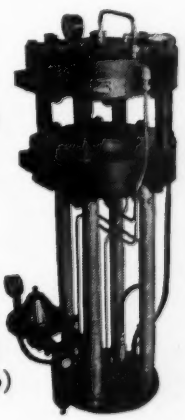
Measurement and control of Thrust and Torque

HAGAN
HALL
BUROMIN
CALGON



COMPENSATING RELAY

HAGAN THRUSTORQ



TYPE SO REGULATOR (Integral Pump)

TUNE IN THE
TEXACO STAR THEATRE
WITH JAMES MELTON
SUNDAY NIGHTS—
METROPOLITAN OPERA
BROADCASTS SATURDAY
AFTERNOONS

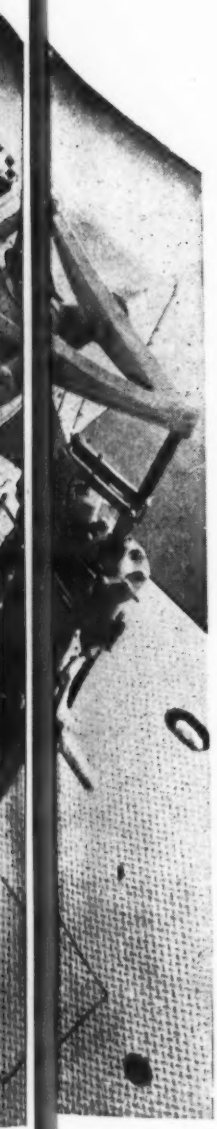
TEXACO

TEXACO

YOUR TURBINES

EXTRA PROTECTION

AGAINST RUST, SLUDGE and FOAM



TEXACO *Regal Oils (R & O)* are the long-famous *Texaco Regal Oils* improved to assure the highest possible resistance to oxidation, rust and foaming. By the "A.S.T.M. oxidation test", *Regal Oils (R & O)* are *more than ten times as resistant to oxidation* as the best uninhibited turbine oils.

Texaco Regal Oils (R & O) give years of service . . . maintain normal bearing temperatures and smooth, sensitive governor action . . . assure increased efficiency, reduced maintenance costs, longer turbine life. They are used by operators all over the world.

Texaco Regal Oils (R & O) fully meet specifications of all leading turbine builders and the turbine oil specifications of the U. S. Navy.

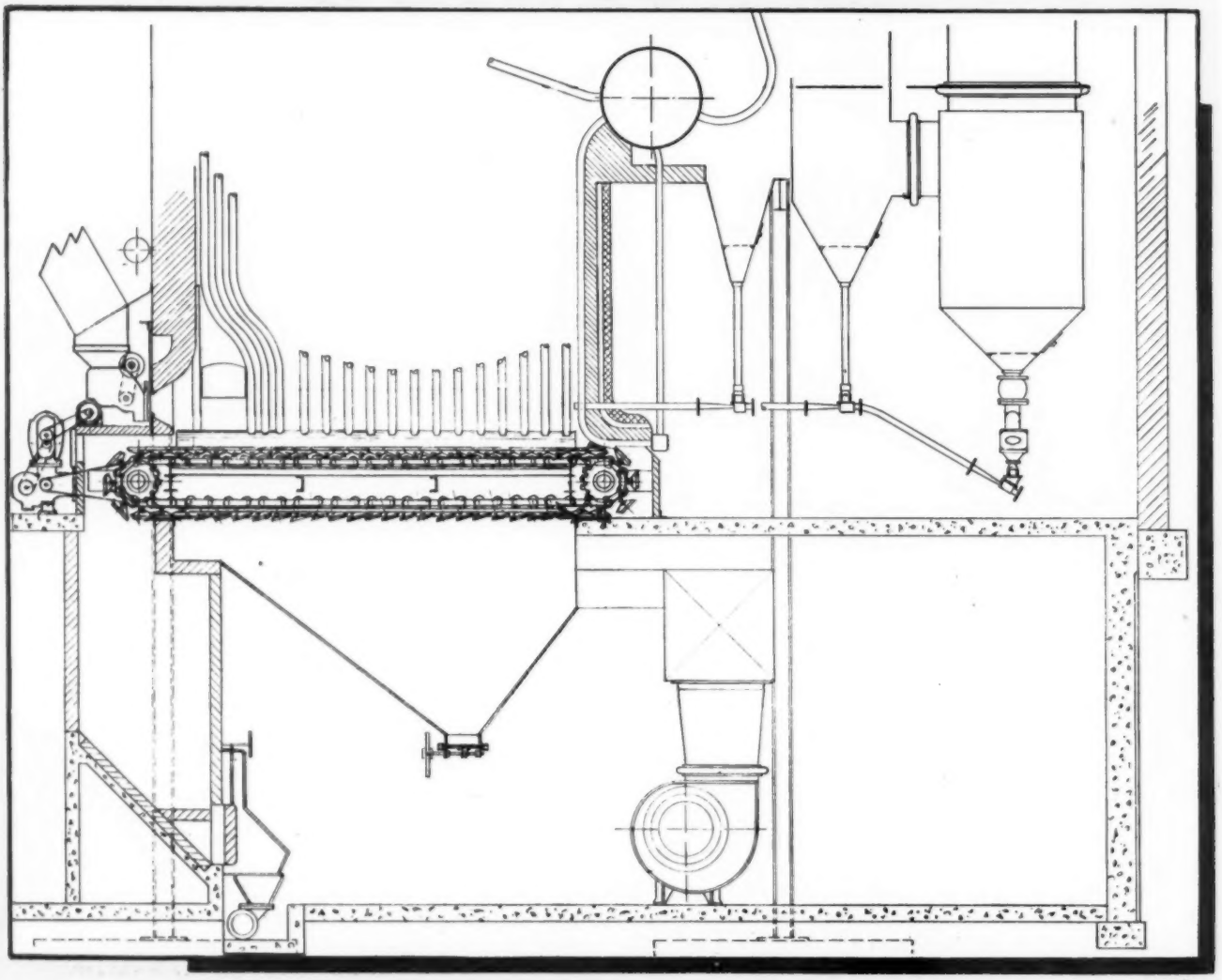
For Texaco Products and Engineering Service call the nearest of the more than 2300 Texaco distributing plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

REGAL OILS (R & O)

FOR ALL TURBINES

HOFFMAN

FIRITE stokers are built in a wide variety of sizes and designs to meet the individual requirements of water tube and fire tube boilers,



TYPICAL SETTING WITH CONTINUOUS ASH DISCHARGE GRATES

Continuously refined and improved through nearly a quarter of a century by the same engineering staff, these products represent the most advanced developments in spreader stoker firing.

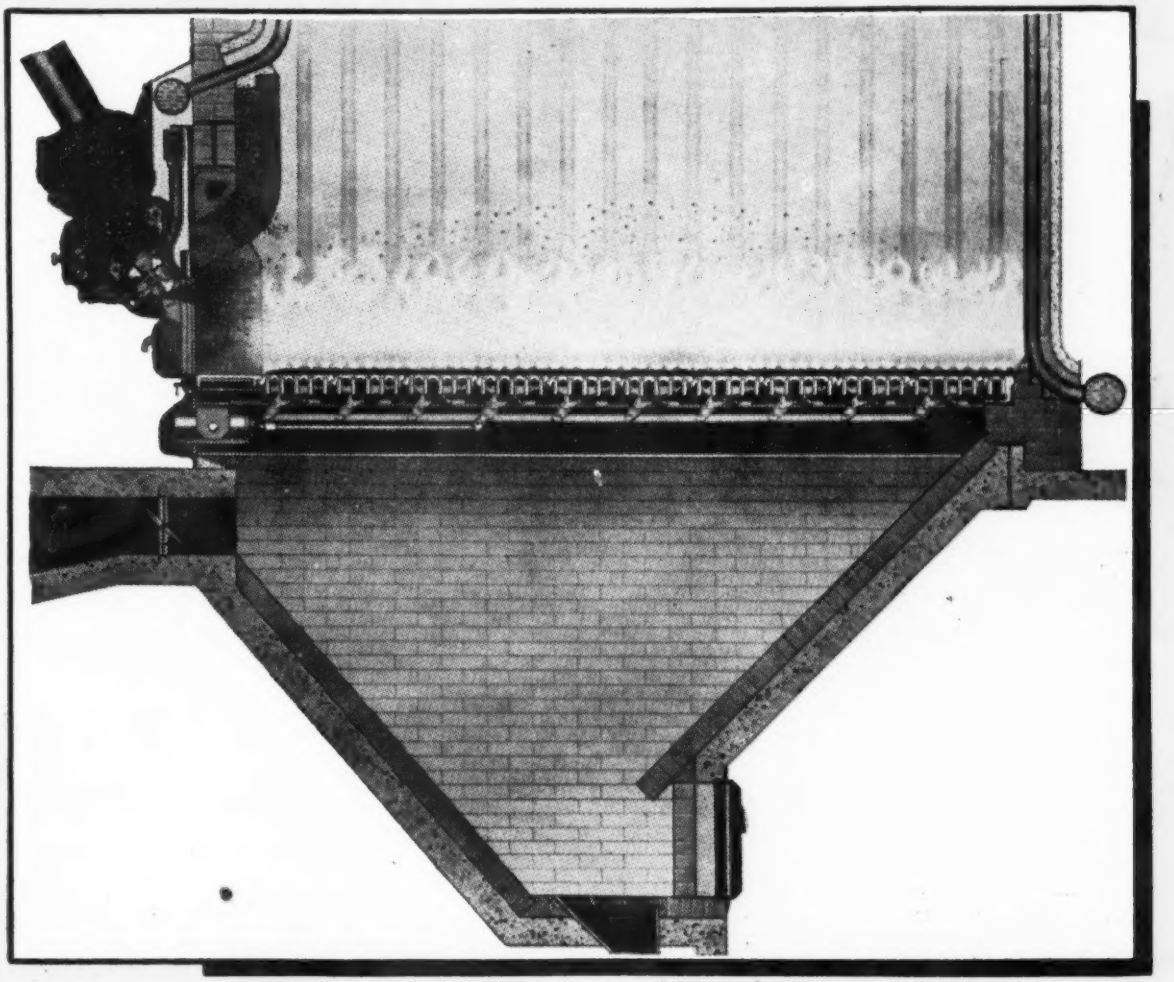
HOFFMAN COMBUSTION

WORKS AT: FAIRMONT, WEST VIRGINIA
DETROIT, MICHIGAN

STOKERS

from approximately 100 HP rating to large steam generating units with capacities of more than one-quarter of a million pounds of steam per hour.

Firite SPREADER TYPE



TYPICAL SETTING WITH POWER DUMPING GRATES

The "know how"... and the "know what" not to do ... gained through the years, in thousands of projects, is at your disposal.

ENGINEERING COMPANY

OFFICES: Marquette Building, Detroit, Mich. Bell Building, Chicago, Illinois
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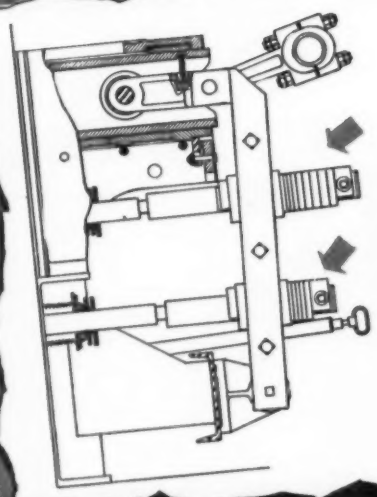
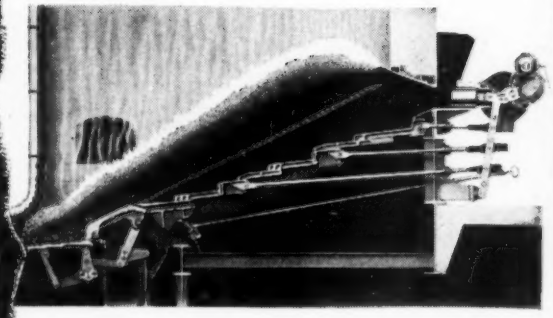
Agents in industrial centers

What a Whale of a Difference!

. . . BUT THE BASIC PRINCIPLE IS STILL THE SAME



SIMPLIFIED FRONT END DRIVE WITH PRECISION — ADJUSTABLE — INDEPENDENT PUSHER CONTROLS



IMPROVEMENTS Make the Difference in Æ Taylor Stokers, Too!

IF YOU examine today's Æ Taylor Stoker, you'll find embodied in *all* its advanced engineering features a singleness of purpose—dependable, low cost steam generation. A typical example is the secondary pusher control feature of the simplified front end drive. These pushers move the fuel with precision throughout its travel on the grate because they operate independently of the coal rams, with basic stroke settings adjustable within ⅛-inch to prevent overshooting. The few modifications necessary can be readily made in operation.

Engineering improvements such as this have continuously increased the efficiency of the inclined multiple retort underfeed firing principle first established by Æ 40 years ago. Under radically changing conditions it has been economy-proved time and again in hundreds of installations of all sizes.

When comparing *any* fuel firing equipment, remember that the modern Æ Taylor Stoker offers you Æ pioneered *basic* advantages combined with exclusive mechanical *improvements*. Complete details are shown in Catalog R-A. Write for it, or ask our engineers to answer your technical questions.

Other Æ Products: Æ-Perfect Spread Stoker, Lo-Hed Hoists, Marine Deck Auxiliaries, Hele-Shaw Fluid Power.

Æ

TAYLOR STOKER

AIR-COOLED & WATER-COOLED

The Only Underfeed Stoker with *all* these Features IN COMBINATION!

1. **Continuous Self-Sealing Ash Disposal**
2. **Movable Ash Discharge Plates**
3. **Smooth-Flow Hydraulic Drive on Rear End**
4. **Independent Pusher Controls within ⅛ inch**
5. **Unique Sure-Feed Coal Agitators**
6. **Silent-Shift Spur Gear Planetary Power Transmission**

AMERICAN ENGINEERING COMPANY

2400 ARAMINGO AVE., PHILADELPHIA 25, PENNSYLVANIA

No-We Didn't Put Sun Helmets and Swim Suits on our Motors-but....

"Double Trouble", moaned the experts, but the Navy stood fast. "All we want", said they, "are starting motors for diesel engines that'll stand up in tropic heat. Make them waterproof too!"

Blood pressures went up, when we ran into short-circuits. Horsepower had to be high (14-22 hp) and frames extra small (1/5 standard size). To offset this, operating periods would never last more than 45 seconds.

Well, we sweated out the high temperature problem — finally licked it with a new method of induction brazing of armature coils. Result: our coil could withstand high temperatures under all operating conditions.

Swimming suits required! Next, we had to waterproof our motors to make them swimmers. So we slipped a spun cover over each unit and sealed it against a neoprene rubber gasket. They shed water like a duck!

"On the beam" was the way those diesel engineers put it when they saw the finished product. And you should have seen the way they beamed after they made their tests. We lost a few buttons off our vests too!

There's a Moral: Every time Allis-Chalmers engineering solves *special* motor problems, we discover new ways to build better standard motors for you. ALLIS-CHALMERS, MILWAUKEE 1, WIS.

A 1928

Wait 'til you see the NEW

ALLIS-CHALMERS MOTORS!

HEAR THE BOSTON SYMPHONY: *Every Saturday Evening, American Broadcasting Co.*

REPAIRS SPEEDED by DOWNTIME REDUCED COSTS CUT

VALVE MAINTENANCE SIMPLIFIED!

All parts of these valves (except bodies and bonnet rings) are exactly the same. They fit each other perfectly. For example—if you need a stem, disc, or seat ring for the "RENEWO", you can use the corresponding part of the "FERRENEWO", and vice versa. Thus there are fewer parts to be carried, repairs are more quickly and easily made. The labor, time, and expense of valve maintenance is cut down—'way down!

IRON BODY
150 lb. S. P.
"FERRENEWO"

BRONZE
200 lb. S. P.
"RENEWO"

☆ ☆ ☆ ☆ ☆ **SEE YOUR LUNKENHEIMER DISTRIBUTOR!**

Lunkenheimer Distributors are located in all industrial centers. There is one near you—have him demonstrate with actual samples the interchangeability of parts in "RENEWO" and "FERRENEWO" Valves. It's a big time and money saver for any plant!

BRONZE, IRON, STEEL AND CORROSION RESISTANT ALLOY VALVES, 125 TO 2500 LB. S. P.;
BOILER MOUNTINGS, LUBRICATING DEVICES, AIRCRAFT FITTINGS

LUNKENHEIMER

Interchangeable Parts

Maintenance men find their job made easier and operating efficiency stepped up by Lunkenheimer interchangeability of parts.

In servicing the Bronze "Renewo" and Iron Body "Ferrenewo" Valves—both regular and plug types—only *one stock of parts* is required. *All* parts (except bodies and bonnet rings) are exactly the same and fit each other perfectly.

Repairs are more quickly and easily made, ordering and handling are simplified. The result: Lower maintenance cost and low ultimate valve cost. . . . . .

Lunkenheimer part-interchangeability is fully illustrated and described in Circular No. 567. Ask your Lunkenheimer Distributor for a copy, or write direct.

THE LUNKENHEIMER CO., Cincinnati 14, Ohio

(OFFICES: NEW YORK 13, CHICAGO 6, BOSTON 10, PHILADELPHIA 7.
EXPORT DEPARTMENT: 318-322 HUDSON ST., NEW YORK 13, N. Y.)

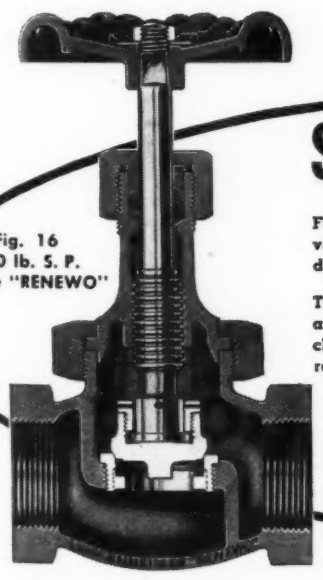


Fig. 16
300 lb. S. P.
Bronze "RENEWO"

SAVE THIS WAY, TOO!

For severe throttling service, a regular type can be converted into a plug type, by simply changing the seat and disc, without taking the valve out of the line.

Thus it's not necessary to buy a whole new valve—just a matched set of plug type seat and disc which interchange perfectly in corresponding patterns and sizes in a range of pressures from 150 to 350 lb. S. P.

Lunkenheimer simplicity of design, minimum number of parts, and fine precision workmanship make this and other outstanding economies possible.

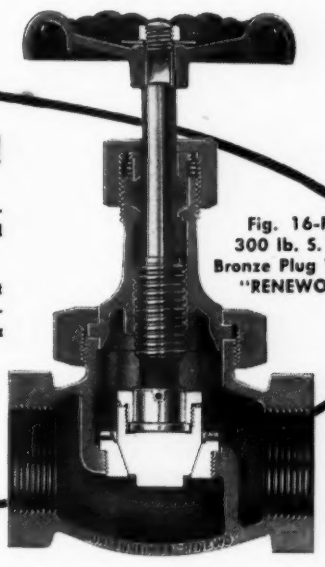
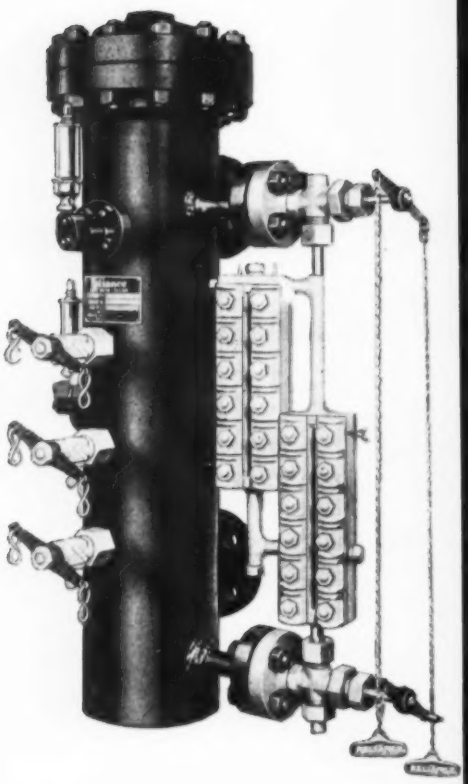


Fig. 16-P
300 lb. S. P.
Bronze Plug Type
"RENEWO"

LUNKENHEIMER VALVES



Double-check

your boiler water levels for safe operation—closer power control—lower costs

Make your water level supervision complete with

The Reliance Gauge Column Company

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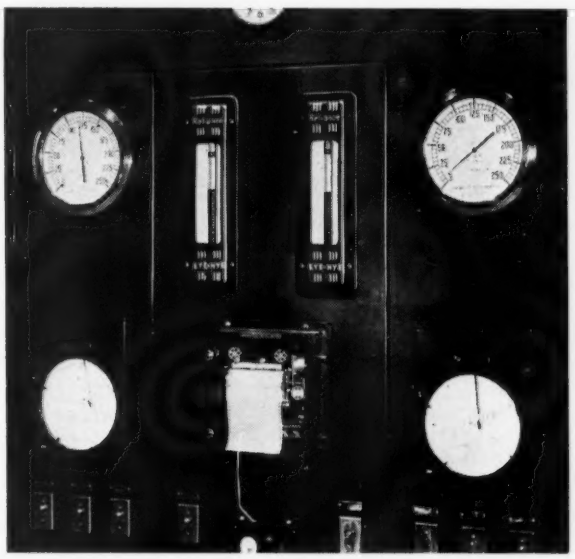
Representatives in Principal Cities to Serve You

Provide extra safety and efficiency through *duplicate* water level supervision

THE Reliance Safety Team double check means convenient frequent gage observation at boiler and control point. Your reward for this two-fold checking facility is more consistent power production—more capacity—lower power cost. It gives you assurance that boiler room men have ample warning of unsafe or inefficient water levels; through *sound* when the Alarm Water Column whistle blows—through *sight* as EYE-HYE shows an accurate reading at all times, conveniently duplicating at control station or other remote point, the reading of the boiler gage. Profitable *double protection.* The cost is extremely small—in view of advantages gained—to make your water level indicating installation complete. Reliance Safety Team water level supervision is profitable on boilers from lowest to highest pressures—even HRT and water tube types—and on accessory vessels such as heater tanks, water storage tanks, etc., in both stationary and marine power plants. Approved by operating engineers and consulting engineers. Write for full information.



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Reliance

BOILER SAFETY DEVICES

ONE *recognized standard*

THE COTTRELL PROCESS OF ELECTRICAL PRECIPITATION

FOR GAS CLEANING, smoke abatement and removal of dust, fume, tar and other suspended matter from gas, there has been one universally accepted process for more than thirty years. In answer to your special problem, a Cottrell installation incorporating this rich experience in research, development and worldwide operation means the complete fulfillment of your requirements.

RESEARCH CORPORATION

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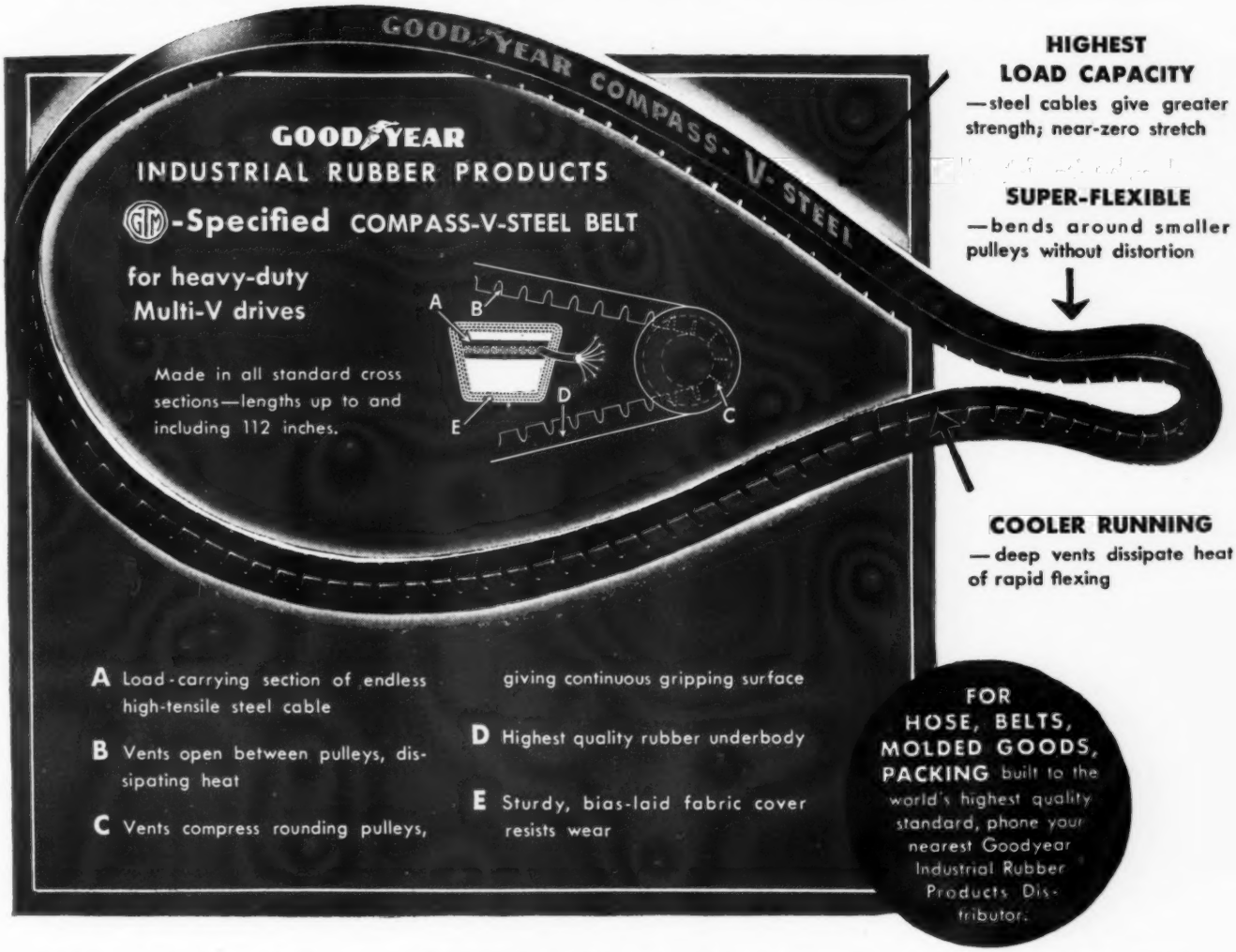
Never a V-Belt like this before!

Sets new performance standards on most critical drives


GOODYEAR COMPASS-V-STEEL
GOODYEAR
INDUSTRIAL RUBBER PRODUCTS
GTM-Specified COMPASS-V-STEEL BELT
for heavy-duty
Multi-V drives
Made in all standard cross sections—lengths up to and including 112 inches.
A
B
C
D
E
HIGHEST LOAD CAPACITY
—steel cables give greater strength; near-zero stretch
SUPER-FLEXIBLE
—bends around smaller pulleys without distortion
COOLER RUNNING
— deep vents dissipate heat of rapid flexing
A Load-carrying section of endless high-tensile steel cable
B Vents open between pulleys, dissipating heat
C Vents compress rounding pulleys, giving continuous gripping surface
D Highest quality rubber underbody
E Sturdy, bias-laid fabric cover resists wear
FOR HOSE, BELTS, MOLDED GOODS, PACKING built to the world's highest quality standard, phone your nearest Goodyear Industrial Rubber Products Distributor.

HERE is a revolutionary new version of Goodyear's famed steel-cable V-belt — the COMPASS-V-STEEL belt. Developed to meet military needs for a super-belt, it now comes to industry with a performance record that surpasses all previous standards. For, as the adjoining blueprint shows, it combines the unrivaled strength of steel-cable load carriers with the new flex-ventilated construction that dissipates heat of flexion, permits bending around smaller pulleys and gives you flat belt flexibility in a V-drive.

This results in many standout advantages. Lower power consumption! Highest heat resistance! Greater strength and shock-load capacity. Practically no creep or slip, no R.P.M. loss! Near-zero stretch — minimum maintenance and adjustments. Widest speed range — from 10 feet per minute up to 10,000! It's the world's most efficient V-belt — *proved on more than 3,000,000 wartime installations!*

Operating-wise, this means you can handle heavier loads, get longer belt life by re-equipping present drives with COMPASS-V-STEEL — or you can get equal efficiency with fewer belts, smaller sheaves and shorter centers, eliminating many present monstrosity drives. For full particulars, horsepower ratings and other data, call in the G.T.M. — Goodyear Technical Man. Just write: Goodyear, Akron 16, Ohio or Los Angeles 54, California.

Compass—T.M. The Goodyear Tire & Rubber Company

GOODYEAR

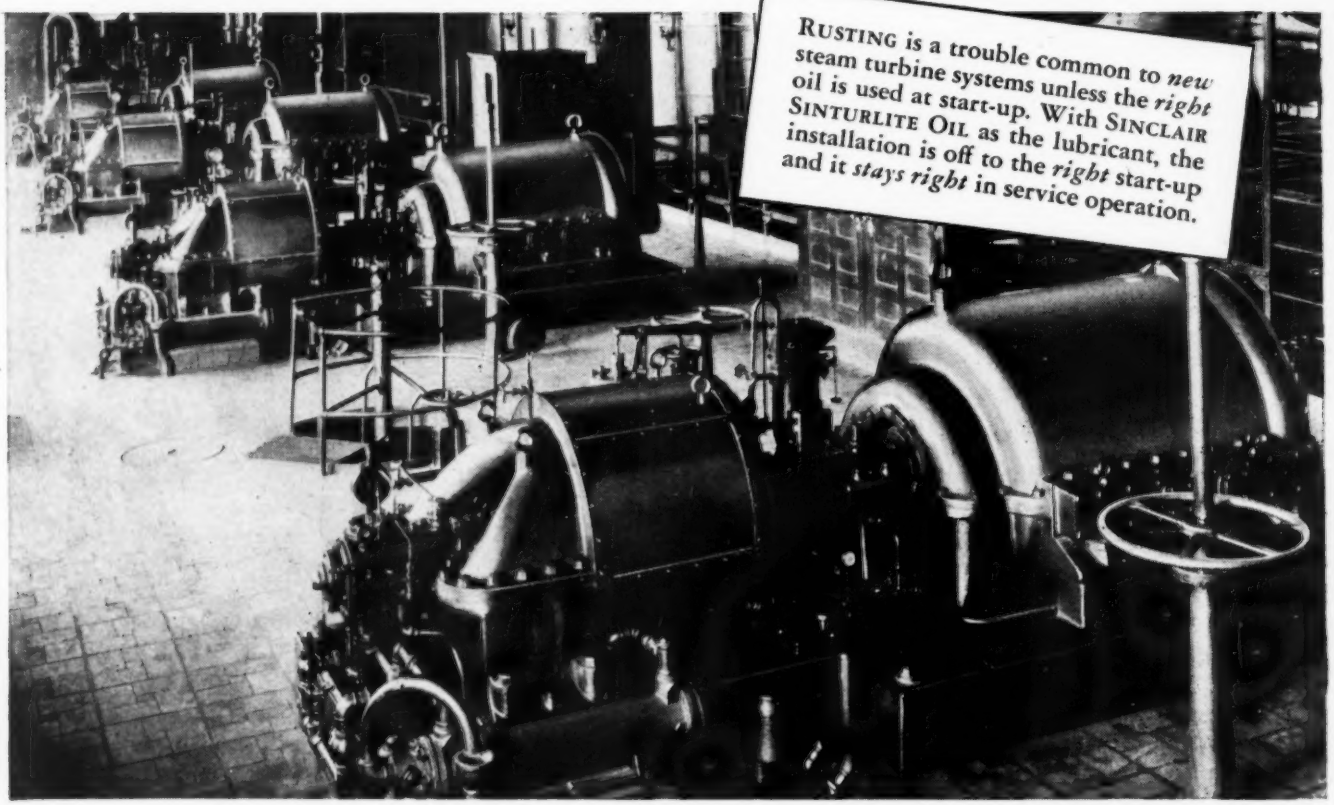
THE GREATEST NAME IN RUBBER

Start-up right

and STAY RIGHT

with

SINTURLITE OIL



RUSTING is a trouble common to *new* steam turbine systems unless the *right* oil is used at start-up. With SINCLAIR SINTURLITE OIL as the lubricant, the installation is off to the *right* start-up and it *stays right* in service operation.

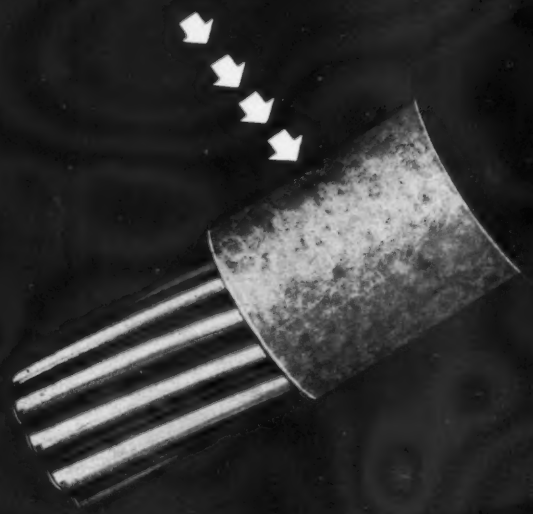
PROTECTION against rust trouble is assured because SINTURLITE OILS are rust inhibited. They are also anti-oxidant and non-foaming . . . have high stability and resistance to formation of deposits. These characteristics mean long turbine oil life and continuous high efficiency of operation. SINTURLITES fully meet requirements of steam turbine manufacturers. Five viscosity ranges are provided to suit varying requirements of installations. Engineering counsel on application of SINTURLITE OILS to your lubrication problems will be promptly furnished.

SINCLAIR INDUSTRIAL OILS

FOR FULL INFORMATION OR LUBRICATION COUNSEL WRITE SINCLAIR REFINING COMPANY, 630 FIFTH AVENUE, NEW YORK 20, N. Y.

National Electric

ASBESTOS WIRE AND CABLE

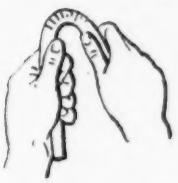


Resists heat, moisture,

oil, grease, fumes . . .

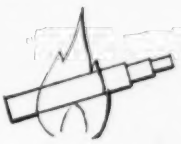
Will not become:

BRITTLE →



BLOOM →

BURN →



ROT →

National Electric Products Corp.

Pittsburgh, Pa.

NATIONAL ELECTRIC PRODUCTS NE WIRING SYSTEMS WIRES AND CABLES

Falk Motoreducers are available in a number of models, of various sizes and ratings, with single, double, and triple reduction gear sets. Illustrations show, above, double reduction all-motor type DU, and, at right, double reduction vertical all-motor type DZX. Both are available in 1 to 75 horsepower range.

Falk is the only manufacturer of the all-motor type of motoreducer. This type permits use of any make of motor in both horizontal and vertical models.

ANY SIZE: for continuous or intermittent service, and for steady variable, or shock loads. Falk Steelflex Couplings are included to provide torsional resilience between motor and gears. Available for floor, wall, or ceiling mounting, with a variety of arrangements providing 16 possible assemblies.

ANY SERVICE: Falk Motoreducers are widely used for mixer drives, agitator drives, conveyor drives, pump drives, dust collector drives, screen drives, classifier drives, shot blast drives, vat drives, fan drives and washer drives.

ANY HORSEPOWER: made to accommodate any standard motor from 1 to 30 H P. on single reduction horizontal or vertical units; from 1 to 75 H.P. on double reduction units; and 1 to 40 H.P. on triple reduction units.

ANY SPEED: gear sets are available for almost any speed from 1430 to 280 rpm on single reduction units; 230 to 45 rpm on double reduction units; and from 37 to 7.5 rpm on triple reduction units, either horizontal or vertical type.

ANY TYPE: any type Falk Motoreducer is available in any speed and horsepower rating range; that is, the single reduction Motoreducer in any particular rating is available in both horizontal and vertical all-motor types. See other horizontal and vertical types illustrated at right.

ANY MOTOR: any standard horizontal ball bearing motor with feet may be used on the horizontal all-motor reducers; any standard vertical type motor on the vertical units.

IT ALWAYS PAYS TO CONSULT **FALK**

Motor-changeability!

A feature of Falk Motoreducers which makes them adaptable to any requirement

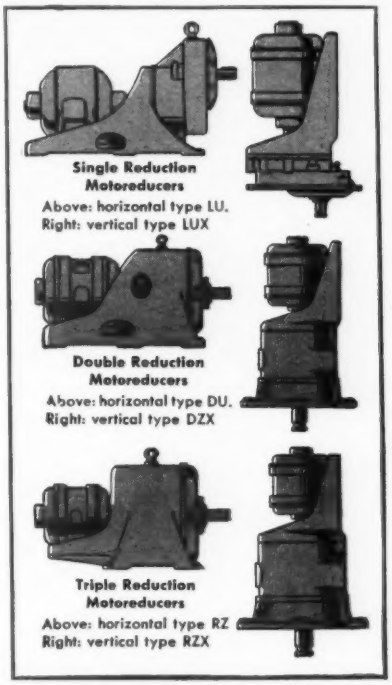
Falk All-Motor units are the answer to the man who prefers to use a motor of his own selection with the gear drive. For Falk All-Motor units make it possible to interchange motors or units, in the plant, on the job, in a few minutes time.

With Falk All-Motor units, illustrated on the left-hand page, you can use any make, speed, or type of motor required, within the rating of the unit. You can interchange motors from one line to another, or from one part of the plant to another. Few spare motors are necessary.

Falk Motoreducers are compact, self-contained unit drives available in either horizontal or vertical models, in horsepower ranges of from 1 to 75 H.P., and with single, double, or triple reduction gears giving an output range of from 1430 down to 7.5 rpm.

Parts as well as motors are fully interchangeable, and you can keep spare parts stocks with the knowledge that they will fit closely without plant machining. That is because of the close tolerances which Falk precision workmanship holds on these parts. Shafts are machined to a tolerance plus of .0000", minus .0005"; tolerance on gearing to within .0001" per inch of face on lead. Profile accuracy of tooth is within .0002".

Gear ratios are quickly and easily changed at little cost. There are no parts requiring adjustment. Absolute freedom from oil leakage is characteristic. Operation is quiet, with reducer efficiencies 98% on single reduction units, 97% on double and triple reduction. A Falk Steelflex Coupling takes care of any possible misalignment and provides torsional resilience between motor and gears.



Single Reduction Motoreducers
Above: horizontal type LU.
Right: vertical type LUX

Double Reduction Motoreducers
Above: horizontal type DU.
Right: vertical type DZX

Triple Reduction Motoreducers
Above: horizontal type RZ
Right: vertical type RZX

Gears are made of high grade Falk gear steel, or, on the larger units, Falk Telastic Molybdenum steel. All gears are heat treated to 285-330 Brinnell, then cut and shaved. Bearings are ball or straight or taper roller, with oversize bearings on low speed shafts to permit heavy overhung loads and thrust loads. Lubrication is through an automatic continuous system of Falk design, multi-sealed to be completely leak-proof. A special pressure system is built into Falk vertical Motoreducers.

Write Falk for Bulletin 3100, which gives details and specifications, and complete selection tables for all Falk Motoreducers for any service. It also contains load classification tables for common applications.

THE FALK CORPORATION, MILWAUKEE 8 WISCONSIN

For over fifty years precision manufacturers of Speed Reducers . . . Motoreducers . . . Flexible Couplings . . . Herringbone and Single Helical Gears . . . Heavy Gear Drives . . . Marine Turbine and Diesel Gear Drives and Clutches . . . Steel Castings . . . Contract Welding and Machine Work.—District Offices, Representatives in principal cities.

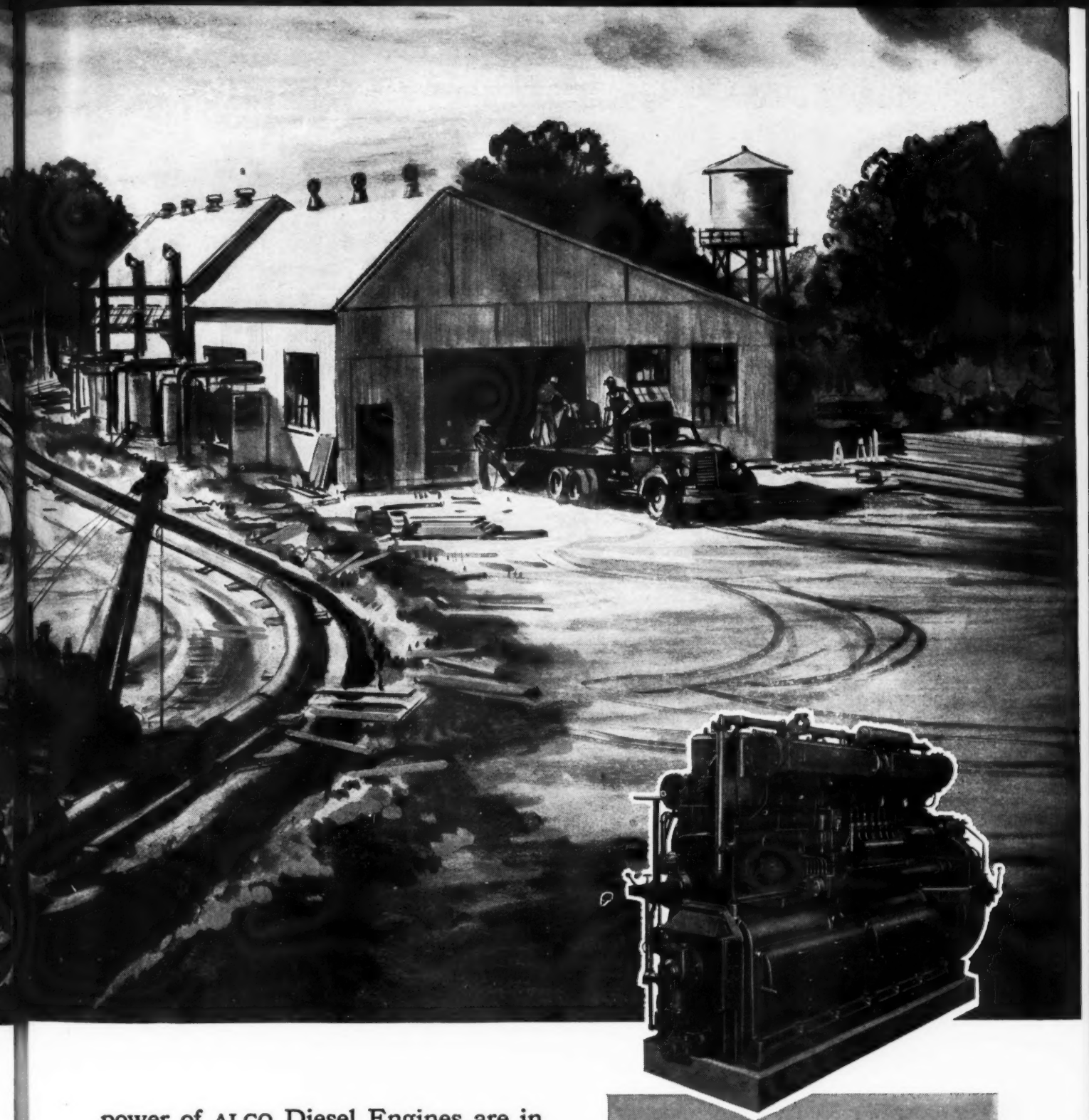
FALK . . . A GOOD NAME IN INDUSTRY

PIPE-LINE EXPRESS!

A pipe line, stretching for a thousand miles. Inside, a column of oil that must keep moving. Pumping stations from point to point. ALCO Diesel Engines, to drive the pumps, meet this vital need for supremely dependable power.

Through pipe lines, ALCO Diesel Engines pump rivers of petroleum and petroleum products to refineries and ports.

ALCO Diesel Engines are light-weight, heavy-duty, compact power units built for every job where quick, adequate, dependable power is needed. ALCO pioneered this new, better type of Diesel Engine. More than 1,500,000 horse-



power of ALCO Diesel Engines are in service for innumerable applications—marine, stationary and mobile.

All we can build are now needed for war work. But soon, we hope, ALCO Diesel Engines, including new important features, will be available to give *you* quick power, efficient power, with maximum space economy and minimum unit weight.

American Locomotive

ALCO DIESEL ENGINES

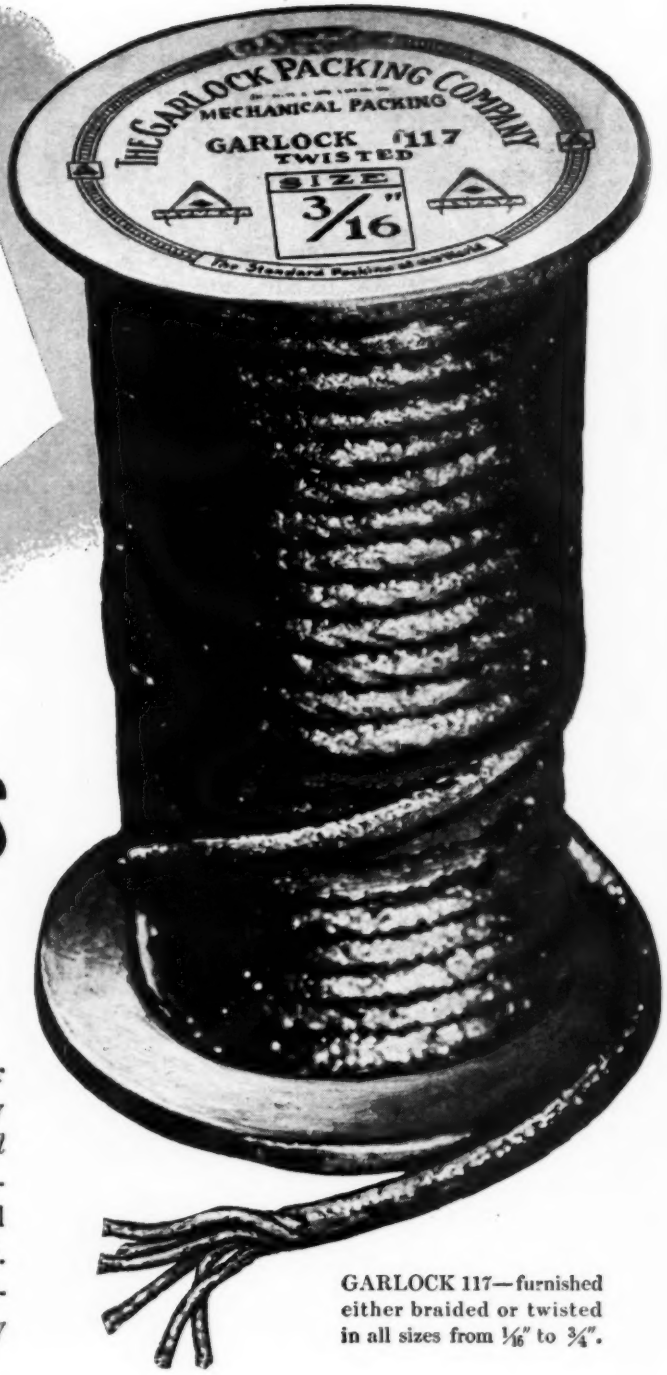
for Universal Application

30 Church Street, New York 8, N. Y.

QUALITY

Controlled

—for TIGHT VALVES



GARLOCK 117—furnished either braided or twisted in all sizes from 1/16" to 3/4".

Garlock 117 Valve Stem Packing, like other Garlock products, is manufactured completely in the Garlock factory and is *quality controlled* from raw material to finished product. Each ingredient, each process, each operation is checked to conform with established Garlock standards.

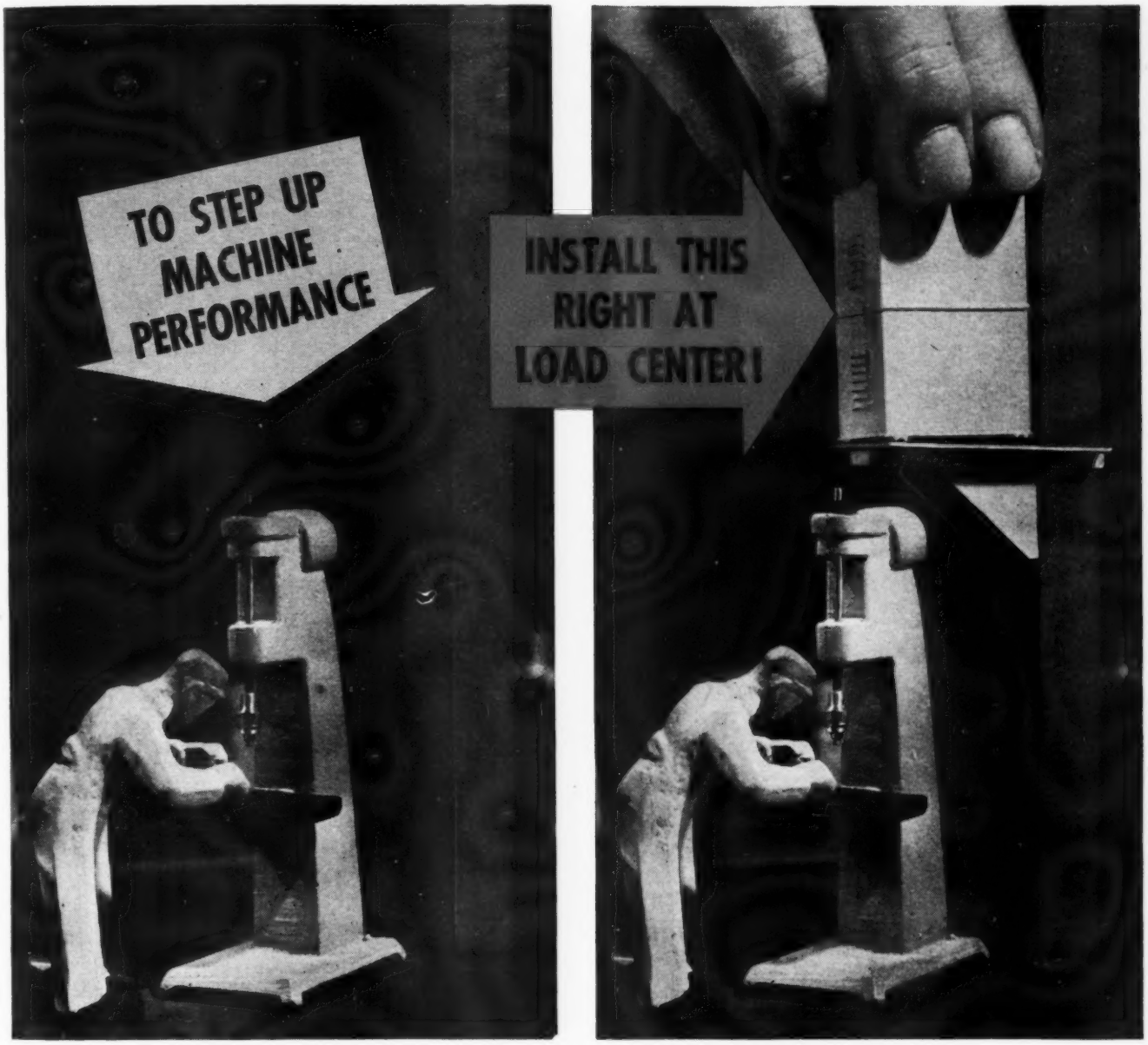
This method of manufacture assures our customers of products that are uniform in quality day in and day out, year after year.

GARLOCK 117 is made from long fibre asbestos yarn, thoroughly lubricated with a special heat-resisting compound. Gives long, dependable service on globe and angle valves operating against high pressure steam, hot or cold water, or oil.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK
In Canada: The Garlock Packing Company of Canada, Limited, Montreal, Que.

GARLOCK

Problem: Solution:



A PROBLEM facing many plants rearranging equipment to meet shifting production demands is . . . how to quickly and economically get *improved* motor and lighting performance. A *sure* way — one that will save you money, man-hours, long runs of heavy secondary copper—is to install Allis-Chalmers Dry-Type Transformers *right at* load centers!

Because they're 1) small; 2) lightweight; 3) won't drip on anything below, these units go up *anywhere* . . . on posts, beams, overhead platforms, etc. There's *no* insulating liquid to test, filter or change . . . *no* oil fire hazard . . . *no* fireproof vaults needed . . . practically *no* maintenance! Get the full facts *now!* Call or write for Bulletin B6027. ALLIS-CHALMERS, MILWAUKEE 1, WIS.

A 1804

HEAR THE BOSTON SYMPHONY: *Every Saturday Evening, American Broadcasting Co.*

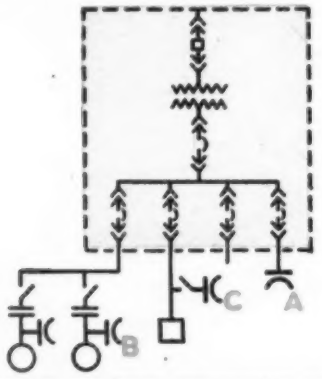
ALLIS CHALMERS *Dry-Type Transformers*

No. 2 HELPFUL HINTS ON APPLYING CAPACITORS

To help you improve power factor, reduce kva demand, increase circuit loadability and, often, reduce power costs

WHERE SHOULD CAPACITORS BE APPLIED?

The greatest *over-all* benefits can usually be obtained by installing capacitors right at the loads, because the "non-working" current is then directly reduced all the way back to the power supply. Transformers, feeders, switches, etc. are thereby enabled to handle more "working" current and to carry



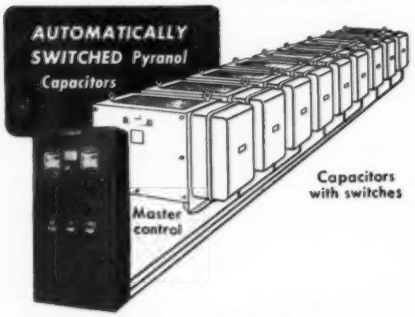
A Capacitor equipment on low-voltage bus
B Capacitors at individual loads
C Capacitor on feeder

increased useful load. Even if the present load is not to be increased, capacitors will reduce the total current, decrease losses, and raise voltage levels.

Sometimes, a single capacitor equipment or a bank of several small equipments is applied on the secondary bus as shown at (A). Less wiring, less labor, and fewer capacitors are required for such installations, but the day-in, day-out savings and other advantages are usually not as great as they are when capacitors are installed right at the load (B). An installation on an individual feeder (C) or a combination of the methods often gives best over-all results.

WHAT ABOUT OVERVOLTAGE AT LIGHT LOADS?

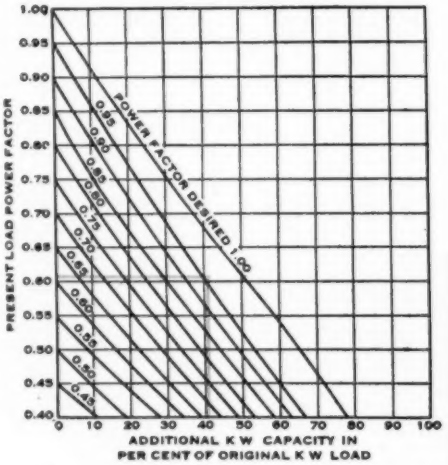
Sometimes the problem of overvoltage on a plant's circuit at *light* load limits the number of *permanently* connected capacitors that can be used. Hence, the *full* benefits of power-factor improvement at *full* load cannot be realized. To solve this problem, *automatic switching equipments* for capacitors have been developed, making it possible to add more capacitors to a given circuit. The capacitors are automatically switched on and off, in one or more groups, in response to load changes. Thus, feeder capacity can be increased at heavy loads without causing overvoltage at



light loads. As shown in the figure above, these equipments consist essentially of three major components: a bank or banks of capacitors, the switching equipment, and the automatic control equipment.

HOW TO CALCULATE THE AMOUNT OF CAPACITY YOU CAN RELEASE BY IMPROVING POWER FACTOR

With this simplified chart, you can estimate the gain in load-carrying capacity for your plant's power system.



Draw a horizontal line from the point at left representing present power factor. This line will intersect the curve representing the desired new power factor. From the point of intersection, draw a vertical line to the base of the chart and read the per cent of new load which your power system can carry after the installation of capacitors.

Example (colored line): Suppose that the present power factor of a 100-kva load is 60 per cent and the desired power factor is 95 per cent. Projection of the intersection of the 60-per-cent power-factor line with the 95-per-cent power-factor curve shows that 41 per cent new load can be carried after power-factor improvement. That is, 41 kva of new load at the original power factor—60 per cent—can be added to the present system.

WHAT ARE KILOVARS?

The many different concepts of "power factor" often result in confusion. In recent years, more and more engineers have given up the lead and lag power-factor concept in favor of "two-quantity" thinking. Basically, this is merely recognition of the fact that in a-c systems two kinds of current are used—that there are two components of electrical load: (1) "working" current—producing kilowatts for power, and (2) reactive current—producing kilovars for magnetizing. By discussing the number of "kilovars" flowing "in" or "out" of a circuit much confusing terminology can be avoided. A full exposition of this subject appeared in the March 31 issue of *Electrical World*, page 64, and is also covered in G-E publications GEA-3637 and GEA-3793, available on request.

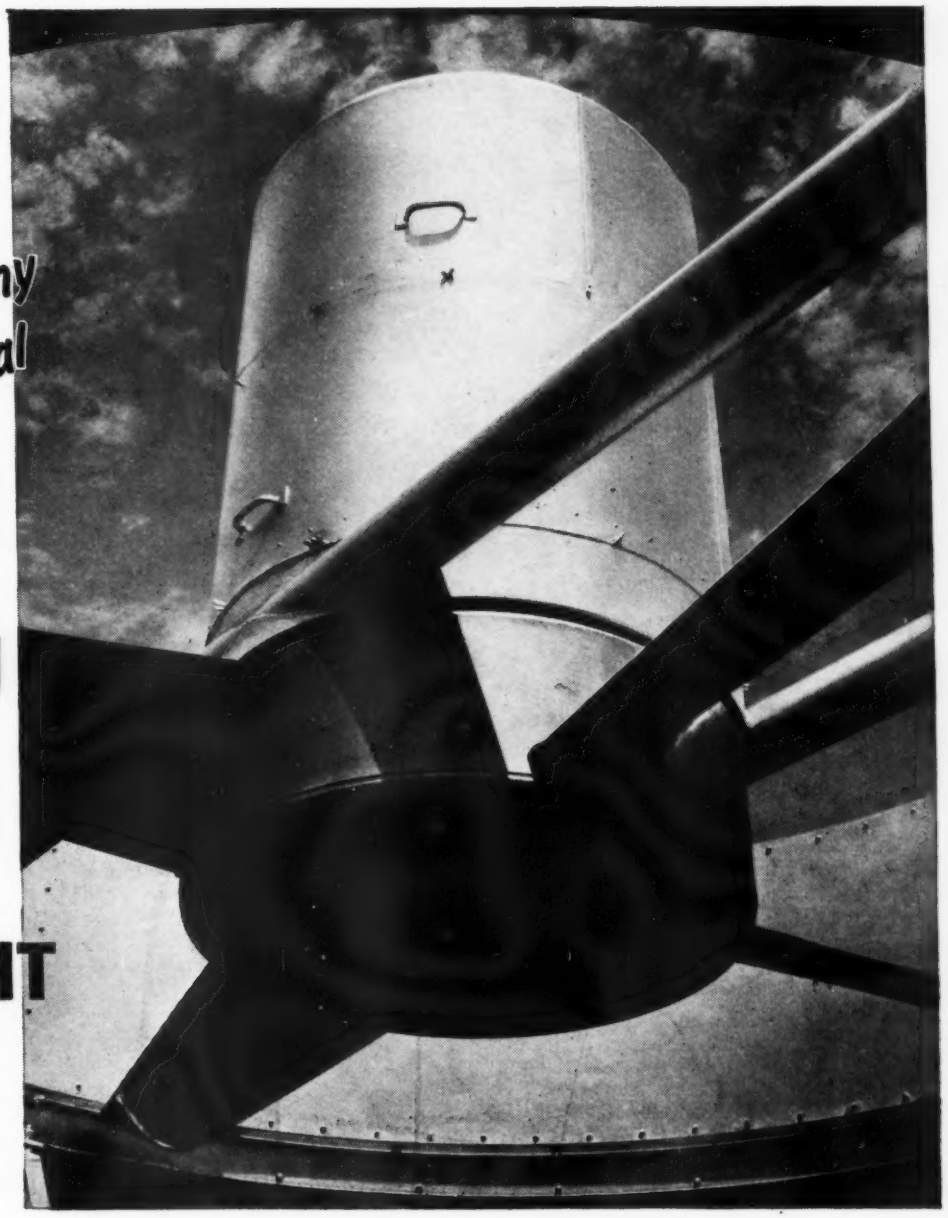
Additional capacitor *application* data can be obtained by writing for Bulletin GEA-3225A. Bulletin GEA-2742C will bring you *product* data on Pyranol capacitors for power-factor improvement. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

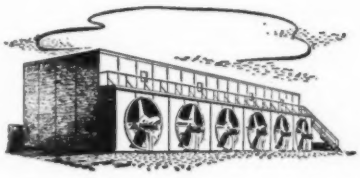
GENERAL ELECTRIC

PYRANOL CAPACITORS

How one company selected a metal to fight...

CORROSION
RUST
EROSION
DEADWEIGHT





J. F. Pritchard & Company of Kansas City, Mo., are among the biggest builders of cooling towers.

In their forced-draft type, air enters near the bottom and courses upward, absorbing heat from the falling water.

The fans that move the cooling air do a *big* job. Diameters range from 7 to 14 feet; number of blades, from two to six. The larger fans handle up to *400,000 cubic feet of air per minute.*

Two factors in the success of Pritchard towers are the design of the huge fans... and the choice of metal.

To withstand corrosive industrial atmospheres and moisture-laden air, the blades are made of wrought Monel, and are individually bolted to Monel hubs. To save weight, the blades are of airfoil section with "stressed skin" design.

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*Reg. U. S. Pat. Off.

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were not found in the textbooks

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3. Instruction of designated employees in making of essential control tests.
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4. Periodic check up by Hall service engineers.
   Experience in hundreds of plants is brought to your plant by these men, and often enables them to detect conditions that might otherwise be overlooked.

5. Periodic checking of samples by Hall Laboratories.
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6. "Trouble shooting" as problems arise.
   If trouble *does* occur, Hall engineers are prepared to trace it to its source, and give all possible help in correcting it.

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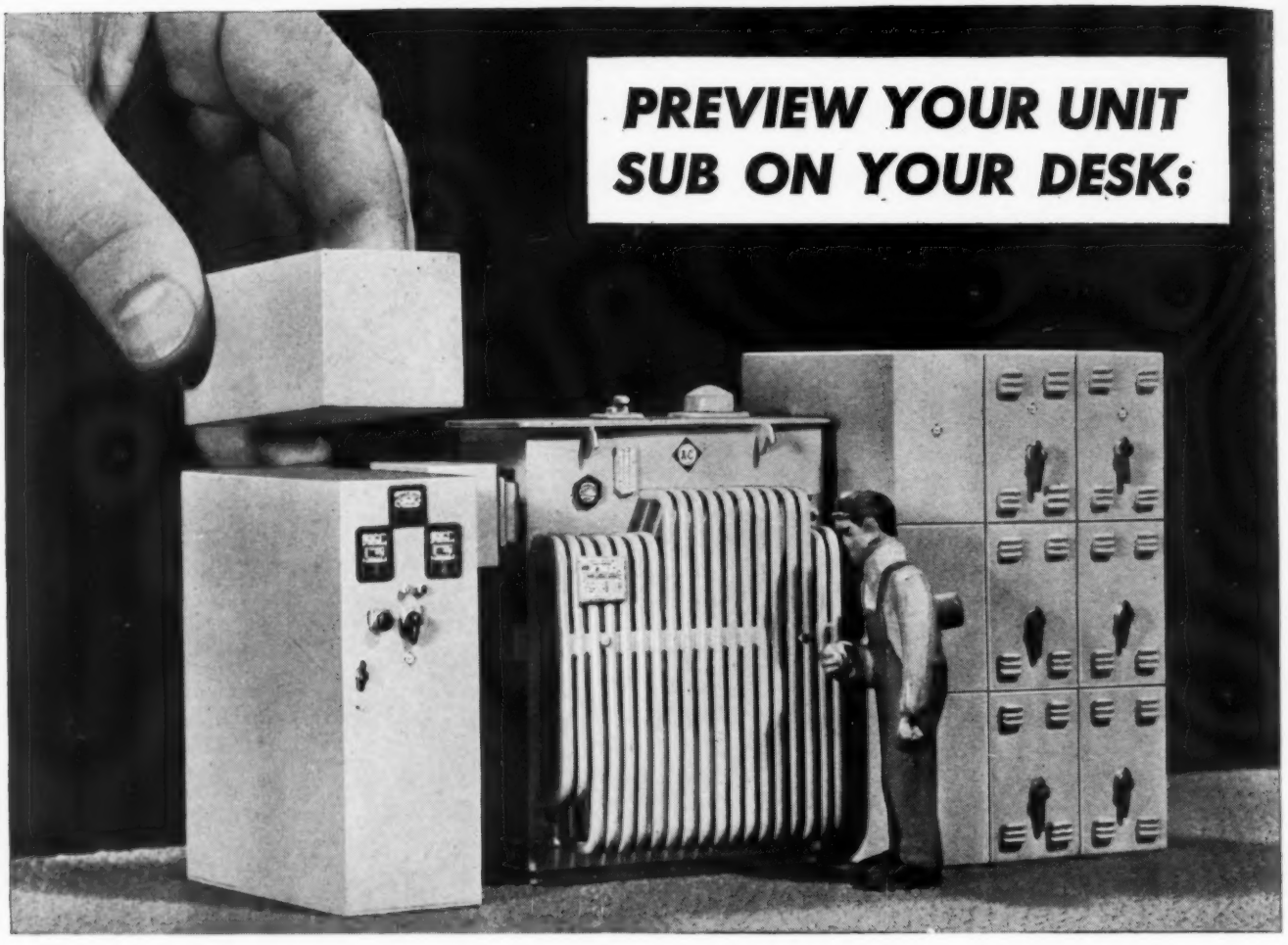

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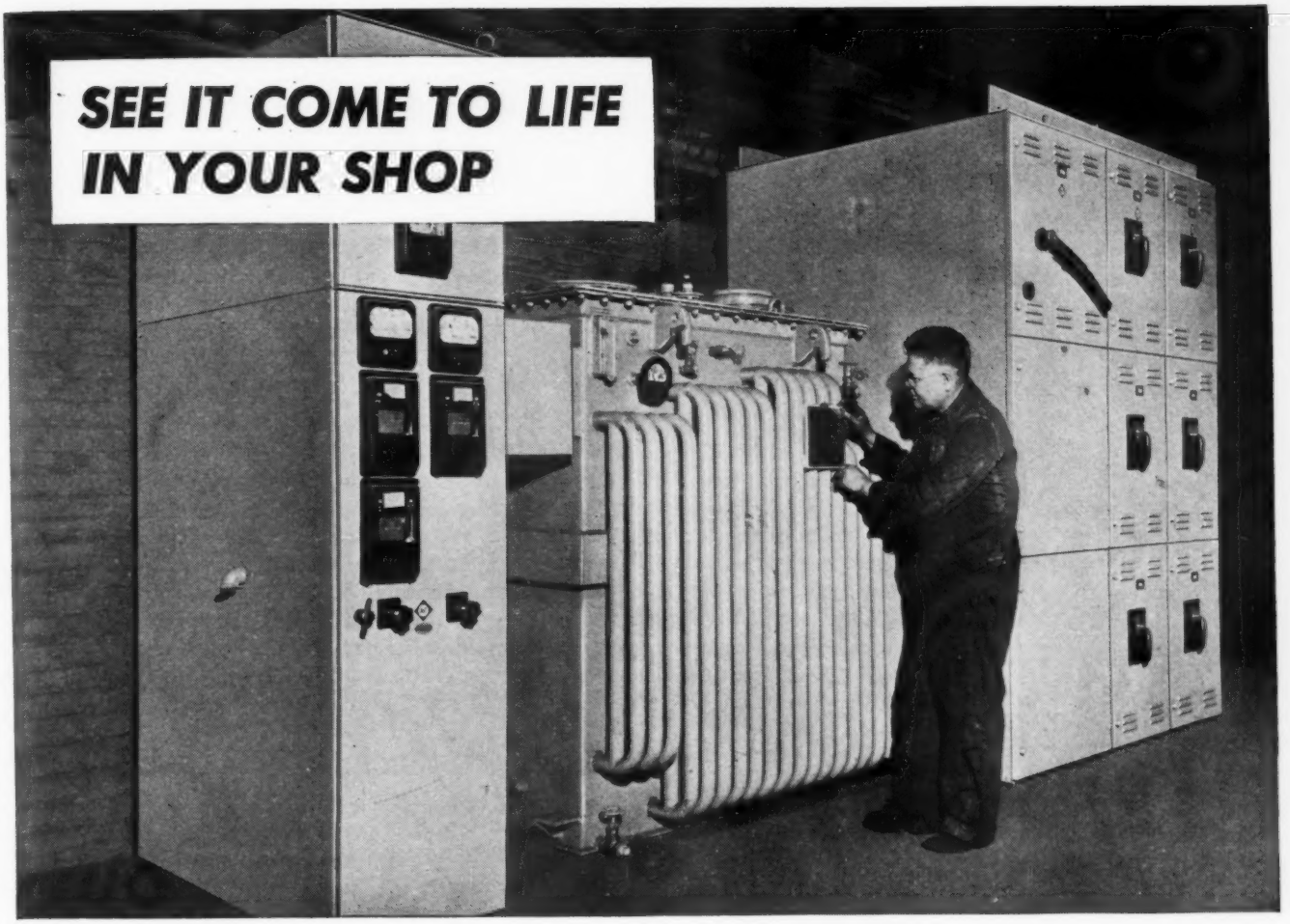

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Fig. 375

Fig. 375—200-pound Bronze Gate Valve with screwed ends, union bonnet, inside screw rising stem and renewable, wear-resisting, taper wedge disc. In sizes ¼" to 3", inclusive. Also available with flanged ends (Fig. 376) in sizes ¾" to 3", inclusive.

Fig. 1708—200-pound Bronze Globe Valve with screwed ends, union bonnet, renewable seat rings and regrindable, renewable, wear-resisting semi-cone plug type disc. In sizes ¼" to 3", inclusive. Also available with flanged ends (Fig. 1702) in sizes ½" to 3", inclusive.

Fig. 241—Iron Body Bronze Mounted Globe Valve for 125 pounds W. S. P. Flanged ends, outside screw rising stem, bolted flanged yoke and regrindable, renewable bronze seat and disc. Available in sizes 2" to 16", inclusive.

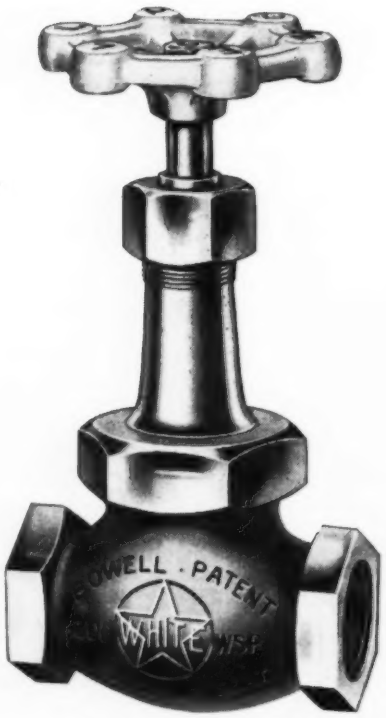


Fig. 1708

Fig. 241

POWELL

for Power Plants

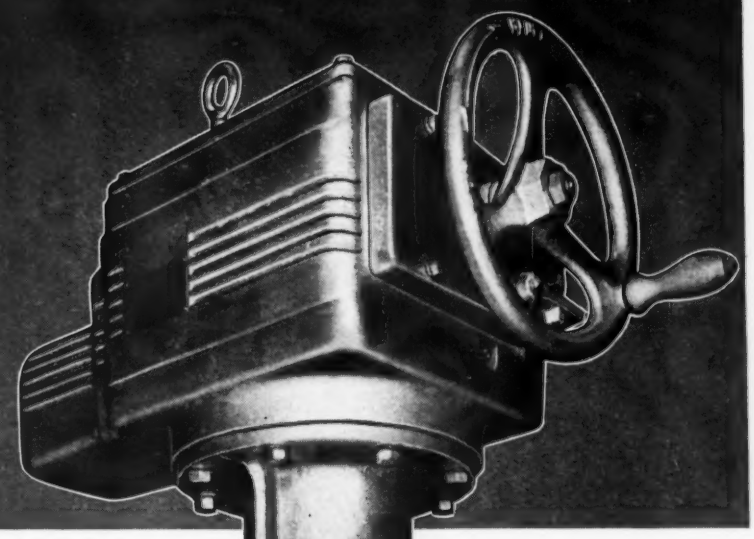
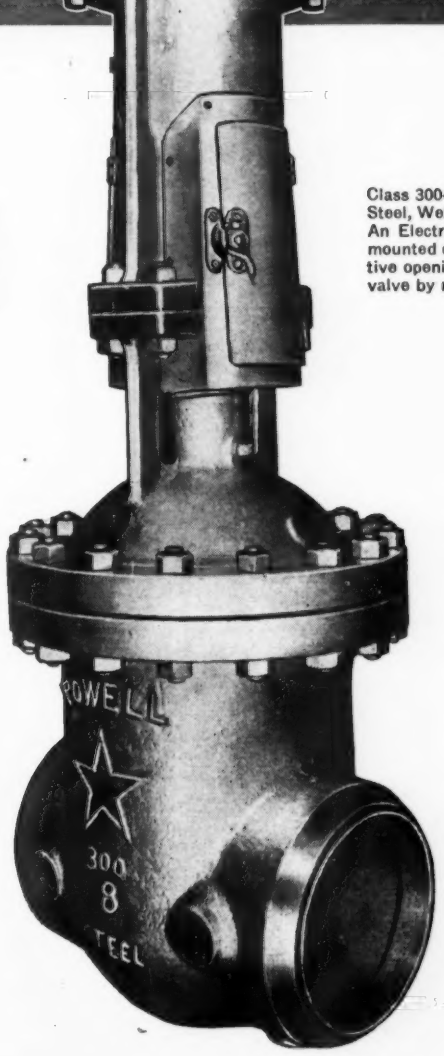


Fig. 1793

Fig. 1793—Iron Body Bronze Mounted Gate Valve for 125 pounds W. S. P. Flanged ends, outside screw rising stem, bolted flanged yoke, bronze seat rings and taper wedge solid disc. Sizes 2″ to 30″, inclusive. Also available with taper wedge double disc (Fig. 1444). In sizes 2″ to 12″, inclusive.



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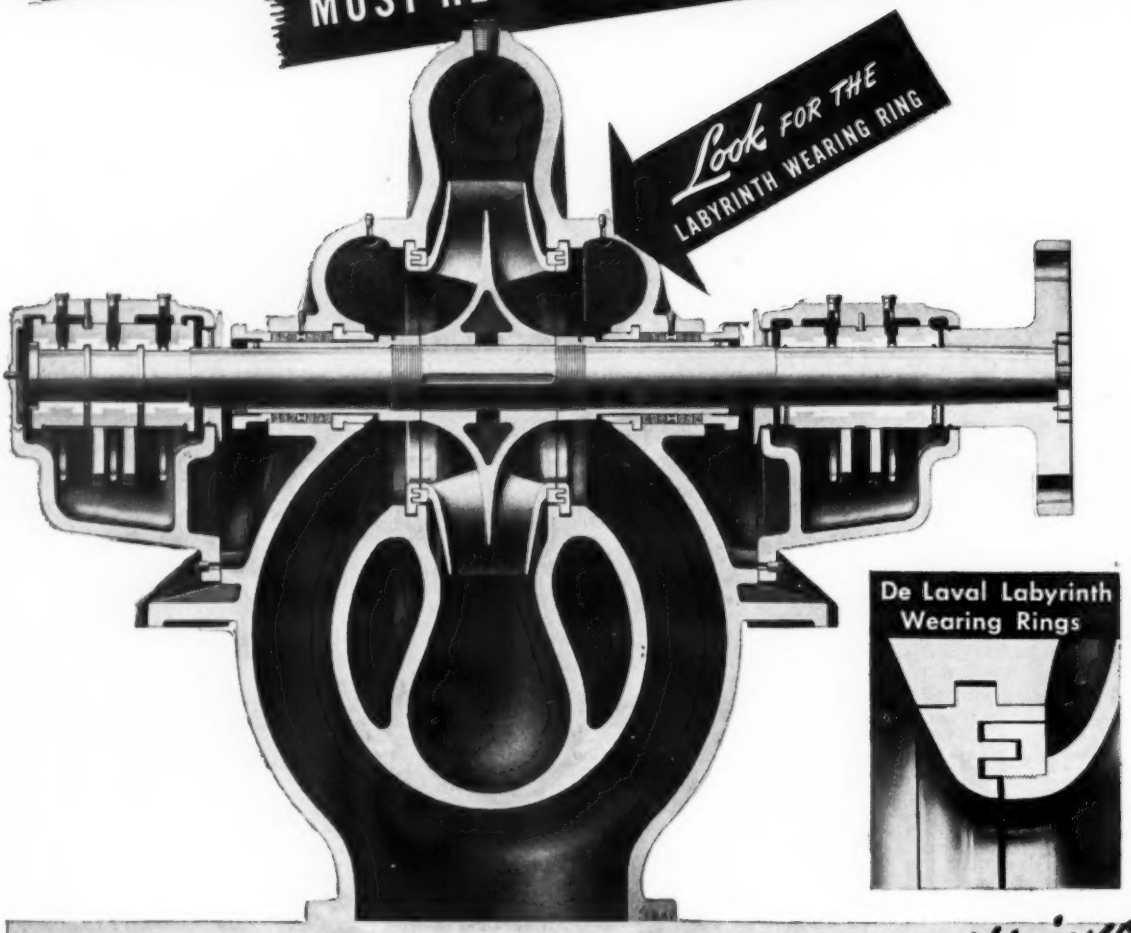

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FEBRUARY, 1946 VOLUME 90, NUMBER 2

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PLANT OPERATING METHODS, MAINTENANCE AND SAFETY
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TURBINES, ENGINES, AUXILIARIES; HYDRO POWER
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TRANSMISSION, LUBRICATION
STEAM SERVICES, HEATING
INSTRUMENTS, CONTROLS
PUMPS, COMPRESSORS

FEATURE ARTICLES

Speedily built power plant helps wrest magnesium from the sea .... 64 →
Draw up those flange bolts uniformly .... 68 →
Big Inch paid $9,000,000 for kilowatts in one year .... 71 →
Condenser and steam-jet air ejector .... 75 →
MAGNETIC DRIVES: a special section .... 79 →
- Magnetic clutches .... 79 →
- Electric slip couplings .... 80 →
- Variable-speed-drive designs .... 81 →
- Speed-reducing-drive unit .... 85 →
- Reversible drives .... 86 →

How to install and maintain diesel valves, seats and guides .... 87 →
Short cuts to plant efficiency: No. 2—The heat balance .... 91 →
Large lumber mill modernizes its electrical power system .... 94 →
How hydraulic axial thrust is balanced in multistage pumps .... 99 →

THE OPERATING ENGINEER

Refrigerant cannot escape from a flawless pipe joint .... 103 →
Practical aids 106
Reader's problems 110
Pump Q & A 114
Math tips .... 118 →
Refrigeration notebook .... 120 →
'How to —' .... 122 →

OTHER DEPARTMENTS

The engineer's bookshelf 124
New equipment 126
Power news 130
Data sheet .... 134 →
George Edwards .... 136 →
New Bulletins .... 168A →

VOLUME 90, NUMBER 2 • ABC • ABP •

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watch

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Thorough combustion. No troublesome clinkers. No periodic dumping of ashes. Operating costs are held down. All these advantages because the Link-Grate keeps the fuel bed porous and lets low pressure air flow through the grates.

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There is little unburned fuel in the ash discharge of a Westinghouse Link-Grate Stoker. Combustion is thorough.

Link-Grate motion maintains a regular combustion rate by continuously processing the fuel bed to keep it porous. Agitation at the rear of the stoker promotes a uniform flow of coal over the underfeed section and keeps the burning lanes open.

Grates first move up to break open the fuel bed and let low pressure air flow through the grates. The downward movement of the grates crumbles and conveys the burning fuel.

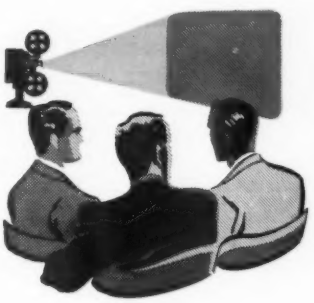
Positive movements of the fuel bed toward the ash discharge eliminates periodic dumping and reduces labor. Clinkers are no problem. Link-Grate motion prevents closed pores in the fuel bed and eliminates the cause of large clinkers.

Ability to handle all types of loads is another outstanding characteristic of the Link-Grate Stoker. It can meet suddenly increased steam demands quickly with full combustion efficiency because the fuel bed is always porous.

Before you make another investment in stokers be sure you have complete information about the Link-Grate. If possible, see one in operation. Your nearest Westinghouse office will be glad to arrange an appointment with a present user. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-50462

SEE A LINK-GRATE DEMONSTRATION IN YOUR OWN OFFICE

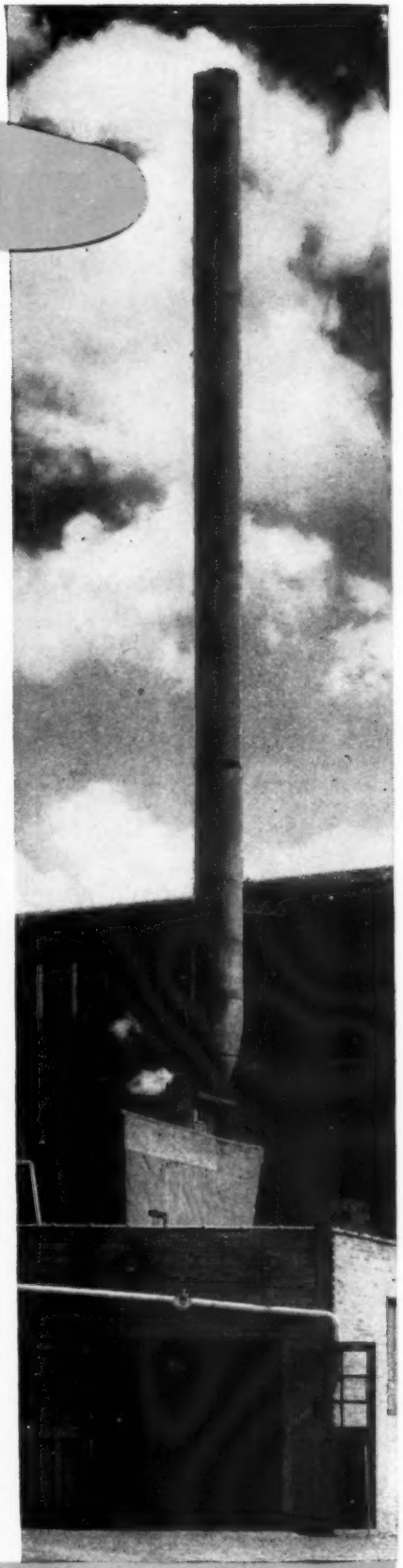
Almost invariably, when a stoker buyer sees a Link-Grate in action he becomes a user. Realizing the difficulty that is often encountered by an individual or group in visiting a stoker installation, Westinghouse has prepared a new 15-minute 16 mm sound movie showing in detail the operation of a Link-Grate Stoker. Prints of this picture are available on loan for your private showing. Just address your request to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.



Link-Grate STOKERS

A stack's worst enemy is corrosion

so they used BYERS WROUGHT IRON



This new wrought iron stack was recently erected at The Firestone Tire and Rubber Company plant in Akron, Ohio. It is 48-inches in diameter and 100-feet high, and replaces one built of low-first-cost materials. Wrought Iron was selected by the engineers in order to extend the periods between replacements.

The most important step in getting a durable stack is to use a corrosion-resisting material, for flue gases and corrosion almost always go together. Any moisture that is present because of a leaky flue, the use of a steam jet "booster," the presence of water in the fuel, or just as a natural product of combustion, may dissolve carbon or sulfur compounds, and thus become an aggressive acid, that attacks and speedily destroys any vulnerable metal.

Wrought iron has proven itself unusually successful in resisting this attack, and in any application where an unlined metal stack can be properly used, the weight of evidence indicates that wrought iron can be expected to last longer than ordinary metals. The most impressive evidence of wrought iron's durability comes from stacks where both it, and other materials have been used. In one such installation, the top section of a 65-foot stack was made of low-first-cost materials, and the bottom 35 feet of wrought iron. In 28 years of service, the top section was replaced twice . . . an average life of 9 years. On the *third* replacement, wrought iron was installed, and was still serving 20 years later when the stack was dismantled. Its condition was so good, in fact, that the stack was sold and re-erected.

The unusual service of wrought iron in stacks is due to its unusual composition and structure. Tiny fibers of glass-like silicate slag, threaded through the body of high-purity metal, halt and diffuse corrosive attack and so discourage deep local pitting. The fibers also help anchor the initial protective film, which shields the underlying metal.

Byers Wrought Iron is available now, in any quantity, for any project, so that your construction or repair work doesn't need to wait on material. You will find some helpful information about wrought iron in the power plant in our bulletin, "Wrought Iron for Flue Gas Conductors and Coal Handling Equipment." May we send you a copy?

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POWER

PHILIP W SWAIN, EDITOR • FEBRUARY 1946 • ESTABLISHED IN 1882

ATOMIC FUEL VERSUS COAL

RECENT COMMENT by many competent authorities has debunked earlier claims made for motor cars and household heaters to be powered by built-in uranium pellets. Even the smallest atomic power plant needs 50 tons of radiation shielding, plus skilled and alert operators. Moreover, to work at all, the minimum atomic plant requires a princely investment in natural or enriched uranium.

So motor cars are out—probably atomic locomotives also. Atomic-powered ships may come some day, but large steam or power stations are the most likely future nonmilitary applications of atomic energy.

Unfortunately discussions of such large-station applications have generally gone off on one tangent or another. For example, the prominent scientists and engineers on the recent Atomic Power Symposium of the National Association of Manufacturers were asked, "How long will it take to develop a power plant of, say, 100,000 kw which could compete with coal selling at $15 per ton?"

Why the $15 figure? Is it implied that the average utility plant pays around $15 per ton delivered? Answering the question as it was asked, the panel members made estimates ranging from ten years to several generations.

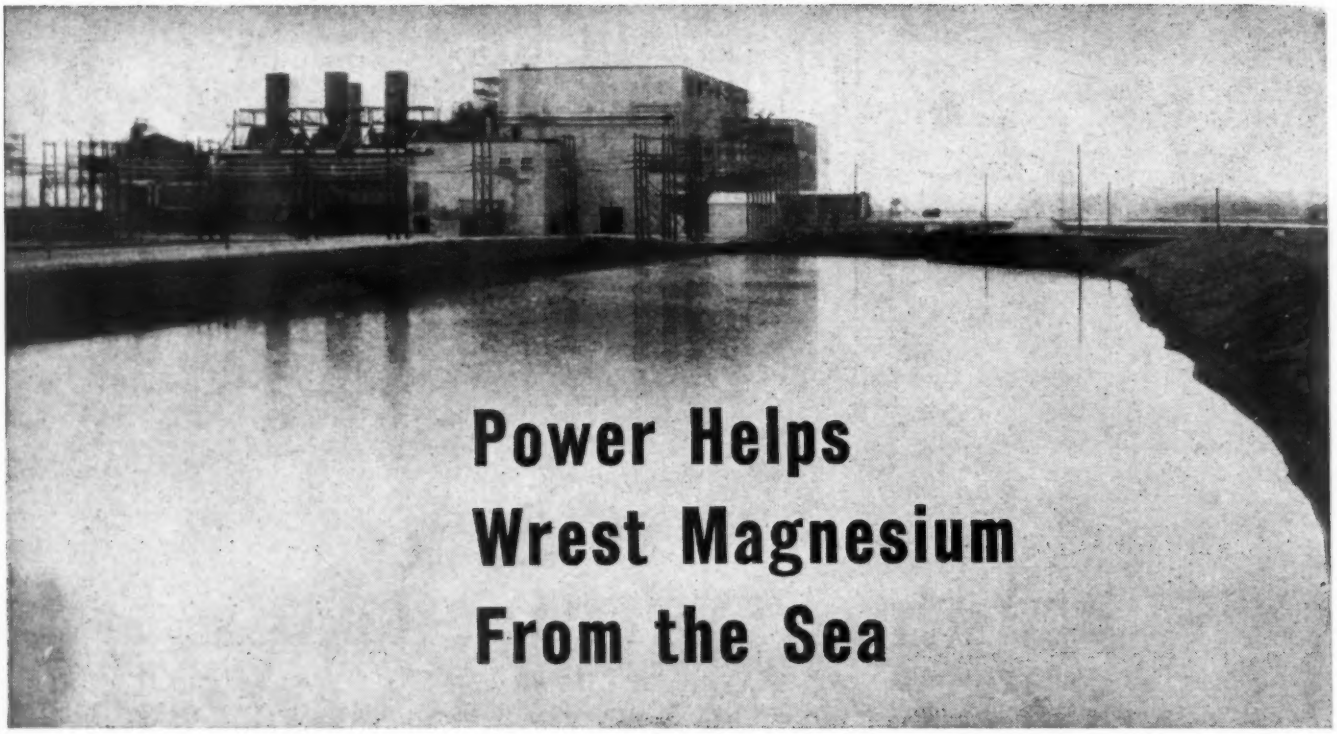
A more practical question would be, "When will atomic-energy-fired *steam*-generating plants be able to compete with coal-fired *steam*-generating plants for plant capacities of, say, X pounds per hour?" The X in the question might be anything from 50,000 lb per hr to 1,000,000 lb or more. This question considers actual future conditions for both coal and nuclear energy. It would also help correct the common but completely unfounded notion that a stationary atomic power plant will, of course, be a plant for making electricity.

If we leave out the gas turbine, atomic energy will first be used to make steam, just as coal is. How that steam is later used need not concern the choice between coal and some nuclear fuel.

This distinction is not mere hair splitting. Of all the coal consumed in medium and large stationary boiler plants, less than half, certainly, and perhaps less than a third, is for electrical generation. In 1945 the central power stations burned 98,000,000 tons of coal (including the coal equivalent of oil, gas and wood burned). No precise industrial breakdown by steaming uses is available, but a reasonable estimate is another 200,000,000 tons to make industrial steam for heating and process primarily, and power incidentally.

Those who expect atom-powered plants to "work an economic revolution" should note that the total coal involved yearly is in the neighborhood of 300,000,000 tons. If we give this an approximate delivered value of 1.8 billion dollars, it will be little more than one percent of the national income. This would be no revolution. And, of course, it can never be a clear saving. We must deduct the cost of "firing" the boilers with atomic fuel.

Despite these comments, it is not our intention to deflate the atom. Atomic energy has been wrongly interpreted, but not overvalued. Nuclear research now started in a big way will some day yield results as great and startling as have the formulations of Newton and Faraday. And most likely there will be benefits we can hardly imagine today.



Power Helps Wrest Magnesium From the Sea

J P Warren, power superintendent, Dow Magnesium Corporation, Velasco, Texas, outlines the development of a hurry-up war-urgent power project. Constantly increasing process needs outstripped available power, forcing use of novel expedients

▶ WAR-BORN DEMANDS for large quantities of magnesium seemed probable to Dow Magnesium engineers so, as early as 1941, plans were laid for a plant to recover magnesium from sea water. Included were modern power facilities, for a large and reliable power supply constitutes a must in this electrolytic process as in all others. Approval of plans, however, was delayed until after Pearl Harbor with the result that urgent demands for other war products and shortage of time combined to make new power equipment unobtainable.

Expected warfare demands for light metal materialized at a rapid rate compelling erection of additional manufacturing capacity from any materials, new or old, then at hand. Accordingly, a 130,000-kw power plant came into being under conditions of stress. Old Ocean Gas Field at Sweeney, Texas, 20 miles from Velasco, held natural gas, which solved the basic requirement of fuel. War Production Board under J A Krug's direction secured the services of both Electric Bond and Share and American Gas and Electric Co to study power requirements in the light of available equipment, and to make recommendations for major power services.

Acting upon recommendations from this source, Defense Plant Corp directed Dow Magnesium Corp to obtain specific equipment located by the recommending party and to direct Austin Co, the contractors, to engage experienced power-plant design engineers as designers and supervisors. Stone & Webster Engineering Corp were engaged for these functions. Further, DPC so cleared the way for the purchase of material and equipment that much of it was en route before the issuance of formal purchase orders.

Among the equipment located by the WPB survey board were: (1) the first six boilers and the first 40,000-kw turbine-generator, crippled and in need of a generator rewinding, installed at Hell Gate Station, N. Y. (2) old No. 6 turbine-generator, 45,000-kw, at Connors Creek, Detroit, then dismantled and stored as obsolete (3) a new partly completed topping turbine, a duplicate of the Logan, W. Va., machine for which no buyers had been found (4) a 2500-kw turbine, casing cracked in four parts from freezing, then property of a bankrupt and abandoned Pennsylvania mine and (5) two 1300-psi steam generators, just built.

Erection proceeded apace with turbine foundations ready and assembly of turbine generators under way before roof or side walls were up. Corrugated asbestos siding covers all but that part housing electrical buses, switch equipment and instruments. Electrical bays are of reinforced concrete paneled with standard building brick. Main control room is a semi-balcony area in the southwest corner of the turbine room, 29 ft above turbine level, with complete air conditioning for protection of instruments against corrosive atmosphere and dust. Cooling fans of 316,000-cfm capacity to insure air movement were installed for a possible complete blackout.

Turbine Room Arrangement

Turbine room, 96 x 230 ft, contains (1) a 100-ton crane spanning the 96 ft, and (2) space with railroad track facilities for unloading equipment. Switch cubicles, 2300-v auxiliary bus, pipe gallery, cooling fans and air-distribution ducts comprise equipment housed on the east side of the turbine room in a lean-to. 26 x 230 ft, whose roof serves as a deck for all 235- and 1250-psi steam headers, reducing and desuperheating stations, relief-valve manifolds, deaerators and sealing-water tanks. This level extends over the fronts of six boilers to furnish a support for six induced-draft fans, and three

stub stacks, a completely outdoor setup.

Location of the plant north of Velasco, Texas, on the Brazos River six miles from the Gulf of Mexico, makes the use of sea water for cooling purposes highly feasible. A dredged canal to the Gulf serves a dual purpose for (1) delivery of sea water to intake flume and (2) transportation artery for incoming raw materials.

Sea water carries through five 2300-v 71,000-gpm pumps, past one pair of traveling screens for each pump into the flume at an elevation of plus 9½ ft, for process, general services and condensers. Chlorinated at this point to restrict growth of microorganisms and crustaceans, 185,000 gpm goes to condensers and power-plant services with discharge into the Brazos at plus 2½ ft on its way back to the Gulf. Main flume cross-section undergoes a reduction at its south end with sheetpiling forming intake and discharge lanes for circulating water. Adjacent to the intake another flume formed by sheetpiling carries waste water from process to merge with condenser discharge. Flood gates, where plant effluent enters the river, afford protection against floods.

Turbine room contains four turbine-generators drawn from widely scattered sources as described above. A new topping unit takes steam at 1250 psi, 900 F to supply process at 450 psi and exhausts into two 225-psi turbines and a desuperheater which, in turn, delivers steam to a 2500-kw house machine that serves as a heat-balance unit.

Only one of these low-pressure turbines has extraction points. That one feeds steam at two low pressures to two feedwater heaters, one of which is located in the discharge path of the condensate pumps of each low-pressure machine. Exhaust from the small heat-balance house machine discharges to a 470,000 gallon makeup tank which receives process returns in condensate form.

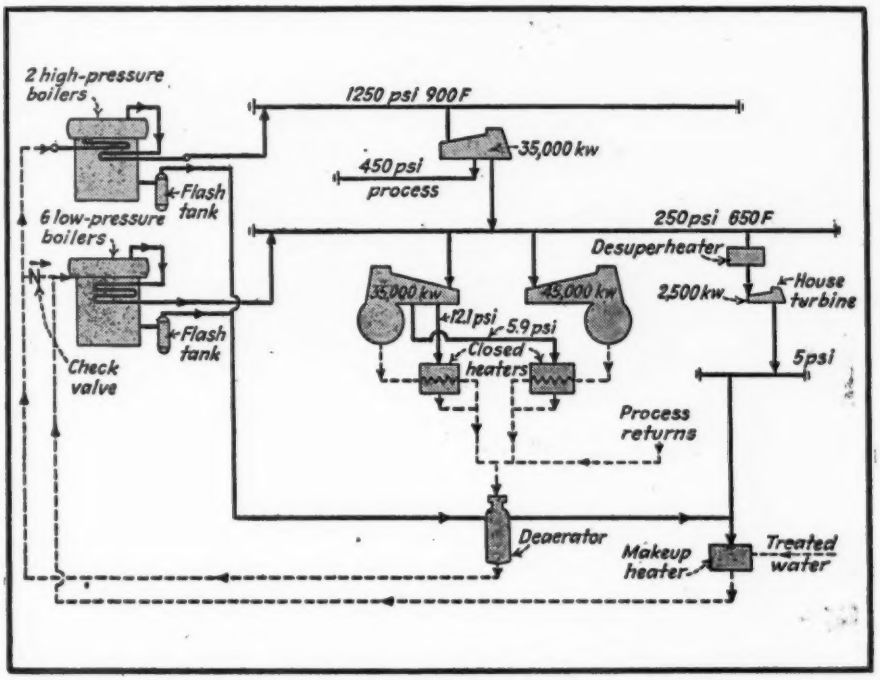
Condensate in Cycle

The extraction turbine exhausts into a 50,000-sq-ft surface condenser requiring 84,000 gpm of cooling water. Exhaust from the non-extraction turbine collects in a 52,500-sq-ft surface condenser receiving its cooling water from two 45,000-gpm circulating-water pumps. Air removal for each condenser is effected by 2-stage steam-jet air pumps.

Condensate from each condenser is pumped through its individual feedwater heater, as previously mentioned, to combine with condensate from the other turbine at the deaerating heaters. At this point two new 500,000-lb-per-hr deaerators equipped with duplicate suction and discharge headers insure continuous feed to a boiler water header. Some of the flow in this header passes through a check valve to join with the discharge from the makeup tank. This combined feed serves the low-pressure boilers. Remaining flow in the header, drawn through an additional pumping stage, has its pressure raised before discharging into the high-pressure boiler units.

Feedwater heating is accomplished by (1) flash steam from blowdown tanks (2) vapor from seals of the topping unit and high-presure packing of the noncondensing turbine in addition to the extraction steam and house-machine exhaust. Water treatment for this plant employs the hot process for water softening. A reserve 250-to-5-psi reducing and desuperheating station stands ready for heating feedwater or serving hot-process water-softening equipment.

Present boiler-room equipment comprises six low-pressure 275-psi 660-F steam generators with superheaters that originally served at Hell Gate Station,

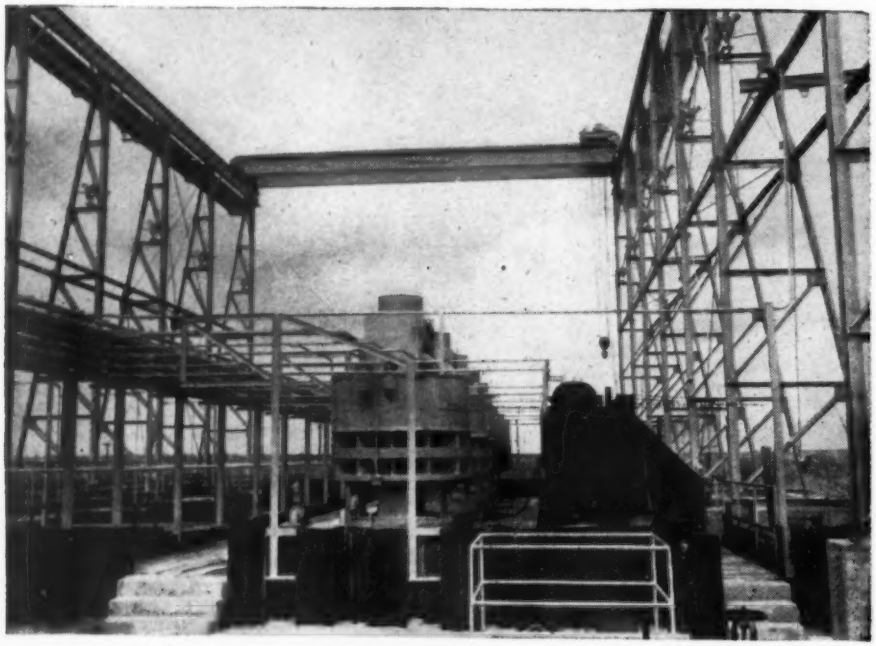


Flow diagram portrays relative positions in station heat cycle of major power plant equipment. Different return points for process and condensate show clearly

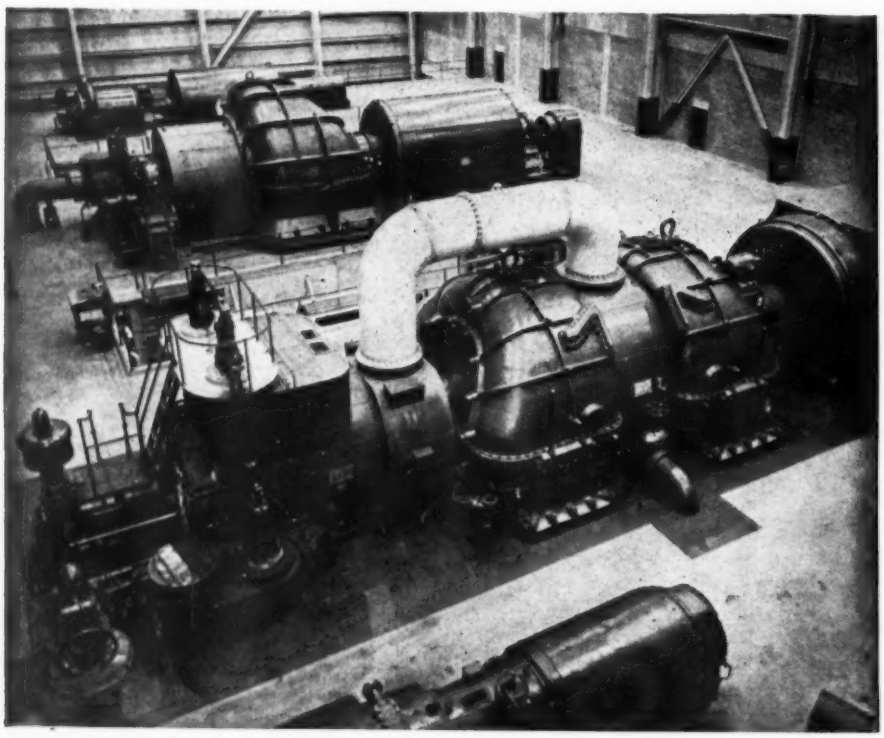
Firing aisle of low-pressure boiler room showing gas-fired burner installations and supply piping for fuel. Some individual and group metering appears in photo

New York, and two new high-pressure 1300-psi 900-F units with superheaters, economizers, air heaters, which supply steam to the topping turbine. Both 250-psi and 1250-psi steam headers are installed outdoors with sectionalizing and lead valves motor-operated. Suitable insulation with an outside wrapping of waterproof sheeting and cement covers all this outside piping. Conventional pipe covering exists on inside lines. A considerable portion of these headers draw support from balanced-spring pipe hangers. Blowdown from each high- and low-pressure boiler passes through a flash tank to permit heat recovery.

Major physical changes occurred in the six low-pressure boilers, which underwent (1) conversion for gas firing (2) installation of rear waterwalls.



Intake screens and the five 71,000-gpm pumps astride a specially dredged 6-mile canal that delivers sea water from Gulf of Mexico for process and power-station cooling purposes. Canal also serves as freight artery to move finished product



Turbine-room view that shows high-pressure topping unit in the background and low-pressure tandem-compound extraction machine in the immediate foreground. Corrugated asbestos siding that lines steel housing of main building appears at rear

All boilers use natural gas as fuel with class 174 fuel oil held for emergencies. Storage for 55,000 barrels of oil with pumping facilities has been provided.

Induced- and forced-draft fans are provided for each installation except four forced-draft fans which serve low-pressure boilers, two for each three units.

Combustion controls for the old 250-psi steam generators consist of remote manual control for induced-draft fan dampers and automatic control for forced-draft fans. The 1250-psi installations carry a pneumatic electric system for automatic combustion control. Compressors mentioned later supply this function.

Controls for Water

Feedwater control for the low-pressure units consists of flow regulators; that for the high-pressure steam generators embodies an air-operated system equipped for remote or local hand operation.

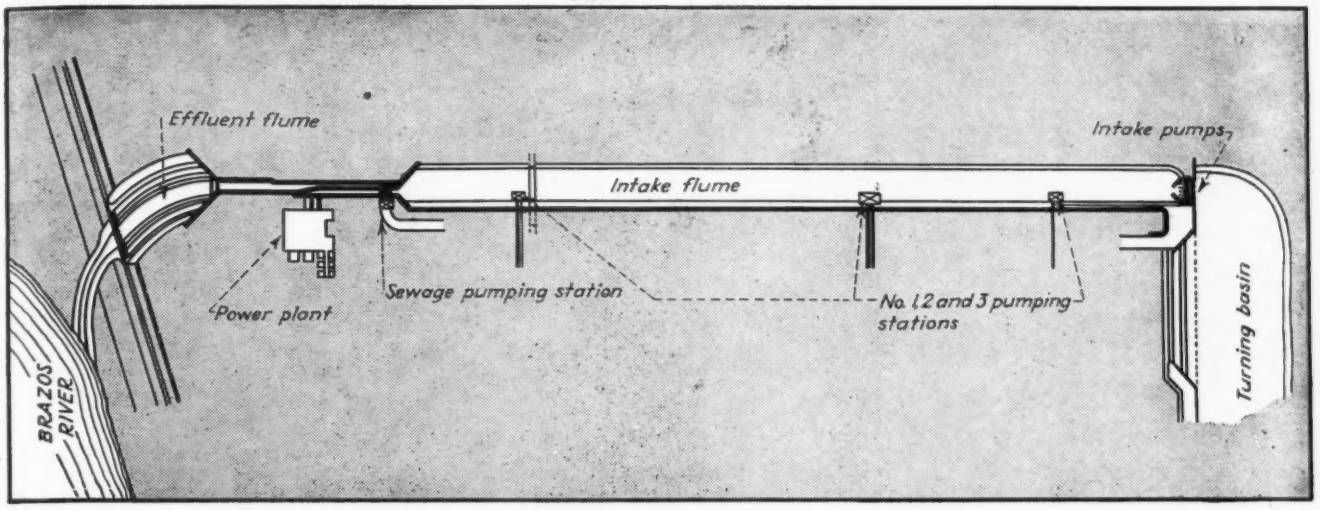
A method of continuous steam sampling from high-pressure boilers draws from two points. One such point is located in the steam line before the superheater and the second after that section. Periodic samples only are taken from the low-pressure boilers.

About 2500 cfm of compressed air meets process and general plant services such as air-operated controls. A group of six compressors supply air at the different pressure levels from 1200 psi down.

Boiler-room operating practices and constructions were both designed for immediate operation under material-shortage conditions. Only the boiler fronts of both low- and high-pressure steam generators are housed; all fans and motors are of the totally inclosed design, installed outside.

Meeting a heavy 550,000-lb-per-hr processing load in addition to steam requirements for generating needs compelled use of stop-gap measures. A demand for 110,000 lb per hr of steam at 350 psi before completion of the high-pressure units found its solution in pressing into service 14 firetube boilers of the oil-field type. This temporary expedient remained an operating member until July 1944 because process steam exceeded expectations, supplying a steadily mounting magnesium output and an addition of load from a styrene plant.

First full-load machine operation occurred in Nov 1942 and by Oct 1943 about 20% of the tubes in one condenser were plugged or leaked. By Nov 1943 a like condition existed in the other condenser. This trouble, along with an out-



Some of the intake flume construction with pumping stations, conveying an impression of the detail involved in protection against flood conditions. Brazos River provides a carry-off for discharged circulating water and process waste

age of one old machine for shaft-straightening and casing repairs following its trial operation, constituted the bulk of out-of-ordinary maintenance.

Load resulting from magnesium manufacture remains free of radical peaks or valleys. Outages and interruptions at the plant are not abnormal for a station on the end of a long transmission line, such as the one that interconnects it with Dow Chemical Co and the Southwestern Power Pool.

Since Dec 1944 operating history of the plant has varied widely. Magnesium production underwent a curtailment under WPB order in that month and equipment, therefore, laid by in readiness for resumption of operations. The power plant continued its operations supplying power and steam requirements of Dow Magnesium Corp (Plancor 243), Dow-Styrene (Plancor 930), and delivering some excess power to the local utility company.

May 11, 1945, WPB directed resumption of a monthly-rated capacity of primary magnesium metal and June 13, two days before schedule, magnesium was poured requiring power-plant operation at full capacity. August 26 of that same year orders again stopped production and equipment was laid by. The power department now serves chlorine manufacture, Dow-Styrene and the local utility for some excess power.

EDITOR'S NOTE: *This article is the first in a series on this plant. Descriptions of the electrical system and the water-treatment plant will appear in early issues of* POWER.

PRINCIPAL POWER-PLANT EQUIPMENT

Dow Magnesium Corp, Velasco, Texas

BOILERS, FURNACES AND AUXILIARY EQUIPMENT:

Boilers, 6.....Springfield Boiler Co
Heating surface 18,900 sq ft, single, cross drum, sectional header, 300-psi design pressure, 600 F, 166,000 lb per hr
Boilers, 2.....Riley Stoker Corp
Heating surface 16,190 sq ft, 3-drum bent-tube integral furnace, 1300-psi design pressure, 900 F, 450,000 lb per hr
Superheaters, 6, multiple loop, each 2135 sq ft....Elesco Superheater Co.
Superheaters, 2, continuous tube, 12,970 sq ft.....Riley Stoker Corp
Air heaters, 2; economizers, 2.....Riley Stoker Corp
Deaerating heaters, 2, 500,000 lb per hr, jet atomizing.....Cochrane Corp
Burners, 24: 4 per Springfield boiler.....Peabody Engineering Corp
Combination gas with straight mechanical oil atomizers
Burners, 20: 10 per Riley boiler.....Peabody Engineering Corp
Combination of ring gas and straight mechanical oil
Condenser .....Westinghouse Electric Corp
One, 50,000 sq ft, 2 pass, divided water box, surface
Condenser .....Foster Wheeler Corp
One, 52,500 sq ft, single pass, divided water box, surface

PUMPS:

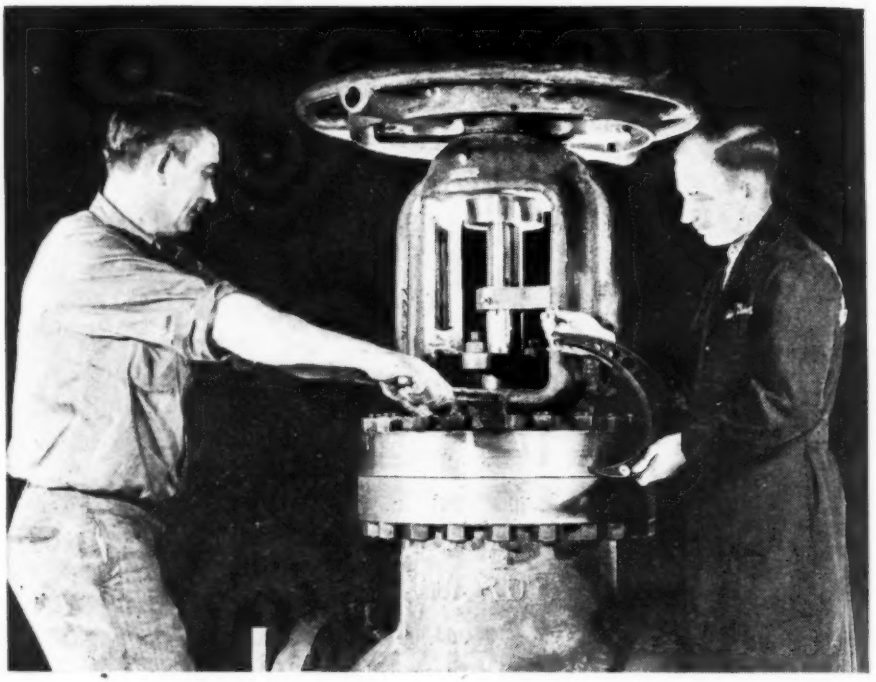
Boiler feed pumps, 5.....Ingersoll-Rand Co
Three, motor driven; two, turbine; two 840 gpm, one 1330, two 1050
Boiler-feed pump, 1, motor driven, 250 gpm, 4 stages..Byron Jackson Co
Condensate pumps.....Worthington Pump & Machy Corp
1100 gpm, 200-ft head
Condensate pumps .....Foster Wheeler Corp
CP-985, pressure-sealed glands, 1100 gpm, 170-ft head
Condenser circulating-water pumps.....Westinghouse Electric Corp
Two, 45,000 gpm, WX2 horizontal, circulating water, 15-ft head
Condenser circulating-water pumps.....Foster Wheeler Corp
Two, 45,000 gpm, axial flow, 15-ft head
Air removal pumps, 2 stage, steam jets.....Westinghouse Electric Corp
Air removal pumps, 2 stage, steam jets.....Foster Wheeler Corp
Air compressors.....Ingersoll-Rand Co
Three, 1000 cfm, motor driven, 90 psi
Air compressors.....Worthington Pump & Machy Corp
Two, garage type, for instrument standby
Air compressor .....Ingersoll-Rand Co
One, motor driven, for 1200-psi turbine's air-operated mechanism
Intake pumps, 5.....Worthington Pump & Machy Corp
71,000 gpm, 54-in., vertical propeller
Forced-draft fans, 4 .....B F Sturtevant Co
120,000 cfm, 2 serving 3 boilers
Forced-draft fans, 4.....Green Fuel Economizer Co
65,500 cfm, 2 for each Riley boiler
Induced-draft fans, 6, multi-vane, 140,000 cfm.....B F Sturtevant Co
Induced-draft fans, 4, 120,0000 cfm.....Green Fuel Economizer Co
Relief valves.....Consolidated Ashcroft Hancock
Boiler valves.....Edward Valves, Inc
Blowoff valves.....Yarnall Waring
Water columns, gages, level indicators.....Reliance Gauge Column Co
Feedwater regulators: 2 high-pressure boilers.....Northern Equipment Co
Flowmatic, air operated, hand or remote control
Feedwater regulators: 6 low-pressure boilers.....Swartwout Co
Combustion control equipment: 6 low-pressure boilers.....Hagan Corp
Combustion control equipment: 2 high-pressure boilers..Leeds & Northrup Co
Pneumatic, electric system, automatic
Conductivity recorder, continuous steam sampling....Powers Regulator Co

TURBINE AND AUXILIARIES:

Turbine-generator.....Westinghouse Electric Corp
One, 35,000 kw, 0.8 pf, 14.2 kv, 72 stage, tandem compound, split-flow with shaft exciter
Turbine-generators, 3.....General Electric Co
One, 45,000 kw, 0.9 pf, 12.2 kv, 21 stage, with shaft-driven main exciter
One, 35,000 kw, 0.8 pf, 14.2 kv, 11 stage, hydrogen-cooled topping unit
One, 2500 kw, 3600-rpm house unit

Draw Up Those Flange Bolts More Uniformly

By LAURENCE H CARR
Director of Research
Edward Valves Inc



Haphazard tightening will not produce a successful flanged joint even when parts are of good material, design and workmanship so check each bolt's loading by one of these methods

Fig. 1—Mechanic tightens the nuts while inspector prepares to check bolt elongation with micrometer. Knowing its original length he can compute stress in the bolt by the amount that it has stretched

▶ TIGHTENING A FLANGED CONNECTION looks like a simple operation. Moreover the proper procedure is easy to describe: Pull each bolt up to the same load and make the total on all bolts great enough to resist the operating forces and maintain the gasket under compression.

In practice, however, several factors complicate the problem. Getting enough total load on the bolts is not difficult since general standardization of flanges —number and size of bolts—and wrench length make it possible for the most inexperienced mechanic to pull the nuts up to a point where total load on all bolts is enough to resist design load. Obtaining practically equal loading on each bolt is much more difficult, but the benefits certainly justify the effort.

This is particularly true of high-temperature applications where the flanges may slowly bend, gaskets deform plastically, and bolts relax. For example, if a flange connection, having bolts originally tightened to loads ranging from 70,000 to 20,000 psi, reaches a temperature of 850 F, the bolts may relax to an operating load of 15,000 psi after several weeks of service. Here the bolts that were originally tightened to 70,000 psi may have accounted for the major part of the total load. However, under high-temperature operating conditions they can support no more than their relaxation strength of 15,000 psi and so a large portion of the original load is lost. On the other hand, if the tightening had been uniform, loss in load would have been lower, Fig. 4.

Basically, bolt load or stress can be measured by only one method: checking bolt elongation. There are several ways to do this: (1) Measure the bolt length before tightening, and then afterwards, thereby determining its elongation, Fig. 1. (2) Heat the bolt to use its thermal expansion as a means of creating elongation. (3) Find, by test, the torque required on a nut to give the desired elongation or stress, Fig. 2, and then check this torque on each succeeding bolt.

Relationship between the load on a piece of steel and the amount it elongates under that load is a fundamental physical quality. Actual tests show that any steel sample, if loaded well below its yield point, elastically stretches 0.001 in. per in. of length under a load of 30,000 psi. When this load is removed the steel returns to its original length. This measurement is like a spring calibration—a measure of elastic stretch under a given load. Fortunately, steel with any degree of hardness, whether carbon, alloy or stainless, behaves the same way so long as the load is kept below the yield point.

This ratio of load in psi, divided by elastic elongation in inches per inch, is called the modulus of elasticity. It is surprising, but fortunate for convenience in calculation, that it is so little affected by varying alloying elements and heat treatments. Strangely enough, a single crystal of iron shows considerable variation in modulus of elasticity along different directions. It goes from 18,000,000 psi in one direction to 42,000,000 in another. Average is 30,000,000 psi and apparently any bar of iron or steel acts as a composite of many tiny crystals whose behavior is the average of the group.

From a practical standpoint, the load up to which a steel sample behaves in this elastic manner is slightly less than the yield point. In other words, if a sample has a yield point of 50,000 psi it can generally be counted on to give an elastic stretch of 0.0015 in. per in. of length and to return to its original length when this load is removed. If the yield point is 105,000 psi, it can probably be loaded to 90,000 to 100,000 psi. In a fully threaded stud or bolt there is, of course, a certain amount of stress concentration at the root of each thread so that a little yielding may sometimes take place at loads below the yield point of a smoothly polished bar. As a matter of record the

modulus of elasticity of materials other than steel is subject to considerable variation. Cast iron is about 15,000,000 psi, aluminum 10,000,000 psi, and brass and bronze 10,000,000 to 15,000,000 psi.

The fact that the modulus of elasticity happens to be so constant for steels at room temperature makes it possible to load any steel stud conveniently to a desired load without knowing the analysis, hardness, prior heat treatment, or even the cross-sectional area at the root of the threads. The desired load need only be divided by 30,000,000 to determine the inches of elongation per inch of length necessary to give that load.

Common Bolt Material

Bolt material commonly used for high-pressure-steel valve flanges is known as SAE 4140 and is heat treated to conform to ASTM Specification A96-39 Class C and A193-44T Grade B7. This heat treatment gives a minimum yield point of 105,000 psi and even in a fully threaded condition, the material behaves elastically to a stress of about 90,000 psi. This means that any inch of a Grade B7 bolt can be stretched 0.003 in. and returns to its original 1-in. length with the load released. In actual practice, the bolts are given something like 0.0015 in. per in. elongation for a stress of 45,000 psi.

This gives a high initial compression to set the gasket firmly in place and stores up considerable springiness in the bolt to take care of subsequent relaxation at high temperatures. However, the loading is not too high to prevent allowances for (1) torsion stresses set up in tightening the nuts (2) bending that may take place from misalignment between spot-faced surfaces, nut-bearing surfaces and nut threads (3) stress concentration at the root of the threads (4) possible increase in load in initial service from the flange heating more rapidly and hence expanding more quickly than the studs.

Elongation is usually measured across the bolt ends. That means they must be (1) ground flat and parallel (2) machined with a small raised section that is ground flat and parallel or (3) countersunk so that small steel balls, Fig. 3, or other measuring points can be inserted in the ends. Measuring is done with micrometers, vernier calipers or especially equipped dial indicators. The device must be readable in thousandths of an inch to be of any practical value.

The fact that the bolts must be measured lengthwise raises the immediate problem that the bolt ends, particularly those portions projecting beyond the nuts, are not stressed. Tests show that the stress in a bolt is reasonably uniform throughout the portion between the two nut faces. At the face of each nut it begins to fall off fairly regularly until it reaches zero at the top of the nut. In other words, if the main body of the bolt has a stress of 50,000 psi, the portion at the center of the nut has a stress of about 25,000 psi and that just projecting from the top of the nut has zero stress.

Total elongation of the bolt within the nut is therefore about half what it would be if that section were uniformly loaded to 50,000 psi. Rather than compute elongation of the main section of the bolt and the length inside the nut separately it is more convenient, and mathematically just as correct, to say that the stressed bolt length is from the center of one nut to the center of the one on the other end, and that the stress is uniform throughout this length.

For example, assume we have a 1½-in.-diameter bolt 10 in. long. If the distance between the two opposite spot-faced surfaces is 6½ in., the distance between nut centers on the two ends is 8 in. because the height of a nut is always the same as the bolt's nominal diameter. If we desire a stress of 45,000 psi, each inch of stressed length should be elongated 0.0015 in., as outlined previously. We consequently multiply this figure by 8 in., the distance between nut centers, to obtain an elongation of 0.012 in. In other words, the original bolt length, as measured by micrometer, should be increased 0.012 in. by tightening the nut.

The constant-torque method of tightening bolts really just supplements the elongation method described. For reasonable accuracy it is necessary to tighten sample bolts to the desired elongation while measuring the torque required. Once established, it can be repeated on other bolts, and presumably they will be given the same elongation and stress. Torque can be measured either by one of the many torque wrenches manufactured, or with a spring scale attached to a wrench of known length. In ftlb, torque is equal to the length of the wrench in feet times the pounds pull on the end of it.

A simple table correlating stress and torque for a variety of common bolt sizes would be ideal, but unfortunately there are too many variables to make such a table practicable. The extent to which the torque on a nut is converted to stress in a bolt depends on (1) finish of the nut face (2) nut thread (3) flanged face (4) bolt thread (5) thread alignment (6) thread fit and form (7) degree of lubrication on the sliding surfaces.

For example, a torque figure set up for an unlubricated nut might be sufficient to fracture a bolt in tension if the nut were well lubricated. However, under fairly constant conditions, the torque method of stressing is quite valuable.

Fig. 2—A torque wrench is reasonably accurate if bolts and nuts are identical within practicable limits and the torque is determined by testing a sample bolt

In any one given plant, where (1) bolts are made of one material on one machine and inspected to a fairly constant degree of finish (2) the spot-faced surfaces of the flange are given a constant finish and (3) lubrication is controlled, it is possible to give nuts a certain torque value in tightening and obtain bolt stresses that are constant within plus or minus 5 or 10%.

An initial stress of 45,000 psi in a bolt may seem high, particularly if one were to consult the table of allowable stress values in the ASME *Boiler Code* and see a figure of 16,000 psi for the same material. This is, however, offset by the fact that the bolts themselves relax and the flanges may bend toward each other slightly because the steel creeps in elevated-temperature service. Also the gasket may flow out into voids in the flanges to become actually slightly thinner. These considerations lead directly to the fact that this quality of springiness in the bolts is necessary.

The 0.012-in. elongation imparted to the previously mentioned example is more or less a measure of the bolt's ability to follow any bending of the flange before completely losing its load. As an example, the flange could give, say, 0.006 in. and the bolt load would be down to about 22,000 psi. Mathematically, the problem is slightly more complicated, but this rough calculation is approximately correct. Hence long bolts are advantageous because in reaching the same initial stress they store up more latent elongation or spring.

Comparing the 1½-in. bolt, 10 in. long, with a studded rather than a through-bolted flange joint, we might find the stressed length of the stud reduced to 5 in. Here, a stress of 45,000 psi would be

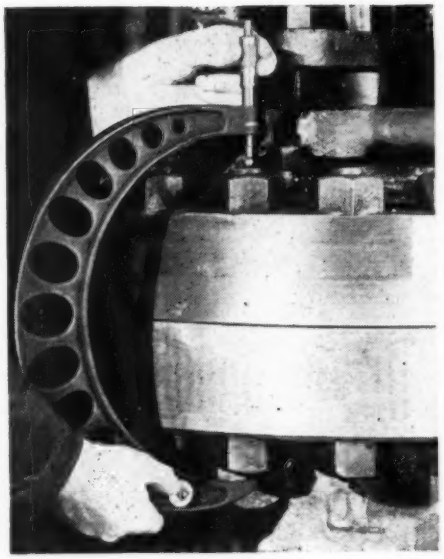


Fig. 3—Bolt ends can be countersunk and steel balls be used for measuring

obtained with an elongation of 0.0075 in. elastic stretch. (45,000 psi ÷ 30,000,000 = 0.0015 in. per in. x 5 = 0.0075.) If the flanges bend toward each other 0.006 in., remaining elongation is only 0.0015 in. in a 5-in. length, which is about 0.0003 in. per in., (0.0075 − 0.006 ÷ 5 = 0.0003), equal to a stress of 9000 psi (0.0003 in. x 30,000,000) rather than 22,000 for the through-bolted type.

These principles can be followed to measure the stress in a bolt after a period of elevated-temperature operation. The obvious way is to measure the bolt across its ends, then loosen the nut and remeasure to find the extent of its elastic contraction. Hence, by calculation with the modulus of elasticity, change in stress from the tight to the loosened condition can be determined. Tests of this nature yield a great deal of valuable information but they must be interpreted with caution.

For one thing, steel's modulus of elasticity unfortunately changes with elevated temperatures. The modulus of 30,000,000 psi at room temperature changes to something like 25,000,000 at 850 F, and 22,000,000 to 20,000,000 psi at 1000 F. This means that for an elastic elongation of 0.001 in. per. in. at 1000 F, the stress is from 20,000 to 22,000 psi. If the flange and bolt assembly were at a uniform temperature of 1000 F and contained elastic elongation and then the entire assembly cooled to room temperature, stress in the bolt would actually increase with cooling even though the elastic elongation within it did not change.

Another confusing factor is the possibility of a thermal difference between bolts and flange. If the flange material is 100 F hotter than the bolt material, it will expand 0.001 in. per in. more than the bolt, thereby creating an additional stress in both bolt and flange. If we assume that half of this was transferred to the bolt in the form of elastic elongation and half to the flange in the form of elastic bending, the increase in bolt stress is about 10,000 psi at the elevated temperature. These complications demonstrate that it is difficult to estimate operating-temperature bolt stress from values obtained at room temperature.

If, however, there is a proper understanding of the underlying principles of bolt stressing, assuming again adequate materials, design and workmanship, a flanged joint will give long and trouble-free service, with the ever-present advantage of being able to break the joint for any necessary repairs without damage.

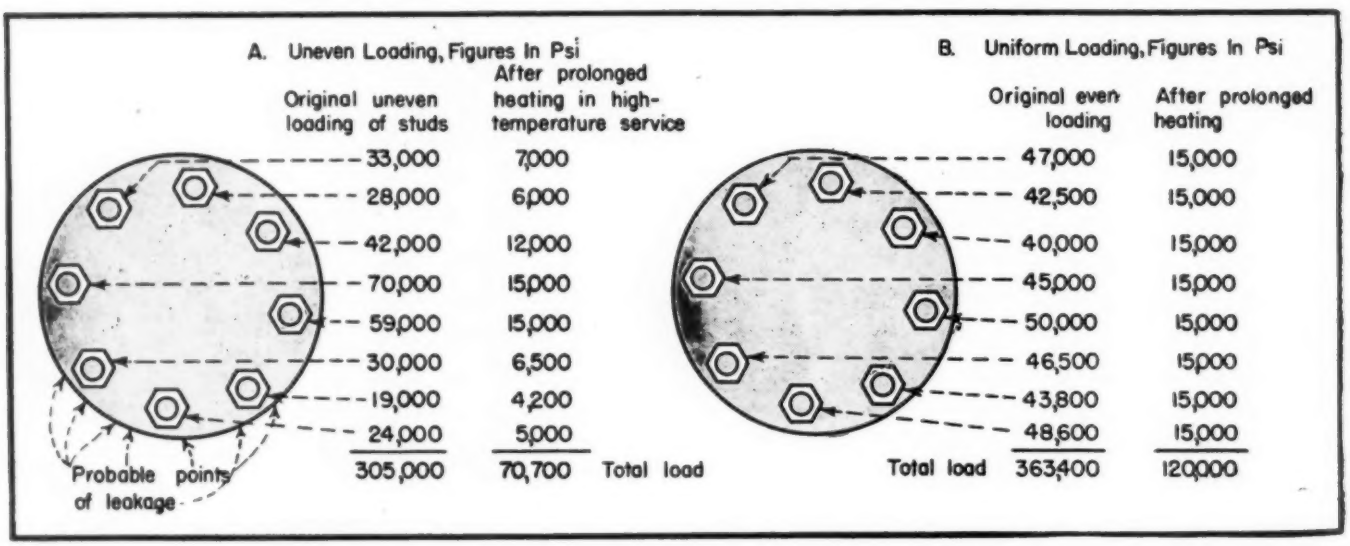
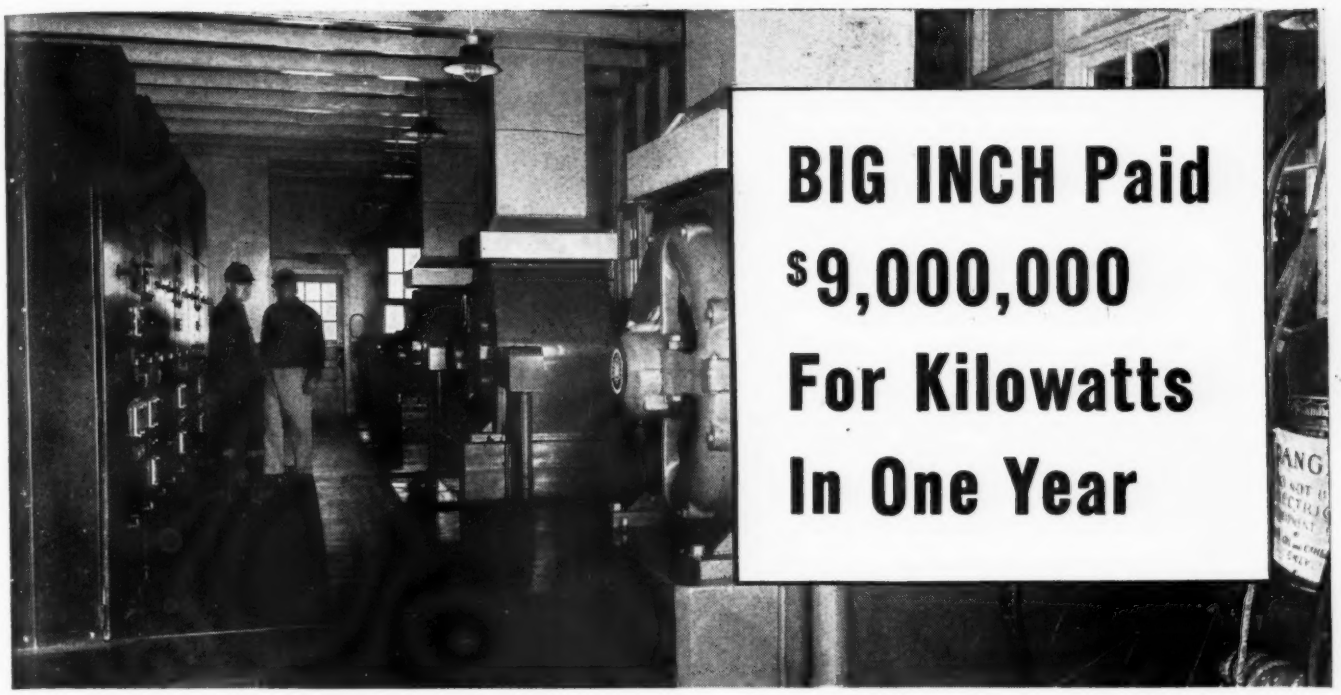


Fig. 4—Unevenly tightened bolts that operate under high temperature may relax enough to reduce the total load to a small fraction of its original value. Evenly stressed bolts maintain a high total load on the connecting flange joint



BIG INCH Paid $9,000,000 For Kilowatts In One Year

Big Inch and Little Big Inch used 3,500,000 kwhr a day to pump oil during the war. Assistant Editor John L King, former electrical engineer of War Emergency Pipelines, describes a year's performance

▶ NOT ONLY ARE THEY the largest pipelines of their kind ever constructed, but Big Inch, the 24-in. crude-oil pipeline, and Little Big Inch, the 20-in. products pipeline, were also one of America's largest wartime industrial-power customers. Together they have 58 pumping stations with about 250,000-hp connected load, averaging 105,000,000 kwhr monthly power consumption, and a maximum of 121,534,475. During the first full year, completed April 1, 1945, that both lines operated together they consumed 1,282,729,624 kwhr at 85.2% average load factor and 89.4% average power factor. Power for the two pipelines was supplied by 19 power companies in nine different states.

In 1944 about 200,000,000,000 kwhr of electrical power were sold in the U. S. Assuming this rate of sale was constant until April 1945, the two pipelines consumed nearly 0.64% of the power sold during the first year's combined operation.

Big Inch is about 1200 miles long, extending from Longview, Tex., to Phoenixville, Pa. There it reduces to 20 in. and branches to Philadelphia, Pa., and Linden, N. J., near New York City, for distribution, making its total length about 1400 miles. There are 27 pumping stations on this line with an average distance of 50 miles between them. Crude stations have three main pump units in series, each driven with a 1500-hp 2300-v 1800-rpm 3-phase squirrel-cage induction motor (see photo above). Each pump is rated at 300,000 bbl per day at 230 psi with 0.85 specific-gravity oil; therefore, crude-oil stations were designed to operate at 700 psi and deliver a throughput of 300,000 bbl per day, Fig. 1.

Booster pumps to pump oil out of tanks are installed at Longview, Tex., Norris City, Ill., Phoenixville, Pa., Linden, N. J., and other stations where tanks are located. These pumps require about 100 hp each and constitute a very small percentage of the total load.

Little Big Inch is 1500 miles long, extending from Beaumont, Tex., to Linden, N. J., with feeder stations at Baytown, Tex., and Lake Charles, La., making its total length about 1550 miles. The distribution system is all concentrated at

Fig. 1—Three crude-oil pumps designed to deliver 300,000 bbl oil a day at 700-psi main-line pressure. Raising pressure to 800 psi increased pumping capacity

Linden, with smaller lines extended to most of the oil companies in that locality. There are 31 pumping stations on this line, averaging 50 miles between stations. Product stations have three main pump units in series, each driven by a 1250-hp 2300-v 3600-rpm 3-phase squirrel-cage induction motor, Fig. 3. Each pump is rated at 235,000 bbl per day at 250 psi with 0.60 specific-gravity oil; therefore, each products station was designed to operate at 750 psi and deliver a throughput of 235,000 bbl per day, Fig. 2.

Crude stations are numbered from 1 to 27 starting at Longview, Tex. Product stations are the same as the crude-line except the first seven. The two lines have different origins and do not come together until they reach Station 5, Little Rock, Ark. The first seven products stations are lettered from A to G starting at Baytown, Tex., but after the stations come together the crude and product locations and numbers are the same throughout to Linden. However different names are assigned to each of the crude and product stations for dispatching and operating identification.

Three-phase transmission lines supply power with transmission voltages ranging from 22 to 110 kv. Because the two pipelines were constructed at different times power transformers and switching stations in general are entirely separate. The secondary voltage is 2300, which is universally used for operating the main pump motors. Operating power for each pump station is supplied from a 3750-kva 3-phase oil-cooled transformer. Switching stations are simple in design and construction, with high-voltage fuses and station-type lightning arresters for transformer protection and air disconnects for isolation.

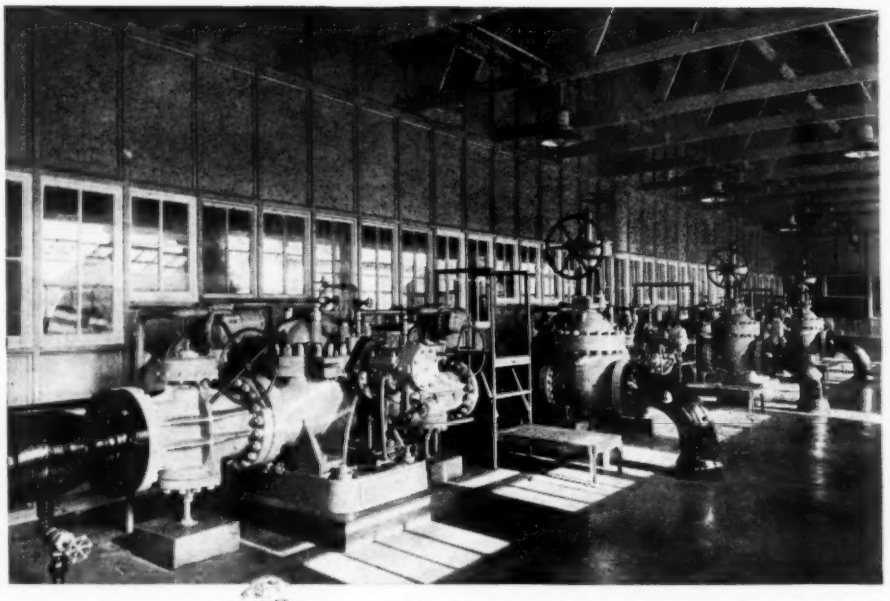


Fig. 2—Main pump units that pump 100-octane gasoline through the 20-in. products line. These huge pumps delivered 200,000 bbl a day at 700-psi main-line pressure

Main pump motors are controlled with metalclad switchgear in the motor room at each 24-in. crude station and in an air-pressured control room at each 20-in. products station. Where power supplies were adequate for across-the-line starting, full-voltage motor starting was used. This type of control was initially installed at 16 stations on the crude line and 17 on the products line. All other stations had autotransformer reduced-voltage starting, Fig. 9. Several of the reduced-voltage-starting stations were converted to full-voltage starting where the power supply was improved after the pipelines were built. Crude-oil pumps are controlled from local pushbutton stations in the pump rooms, and products pumps from a specially designed control board in the air-pressured control room, Fig. 8.

Performance curves showing kilowatt-hours, cost of power and load factor for each month of the year's operation are shown in Fig. 4 for the 24-in. crude line and in Fig. 5 for the 20-in. products line. Barrels of oil pumped, thousand-barrel miles and power costs per barrel for each month are shown in Fig. 6 and 7, for the 24- and 20-in. lines respectively.

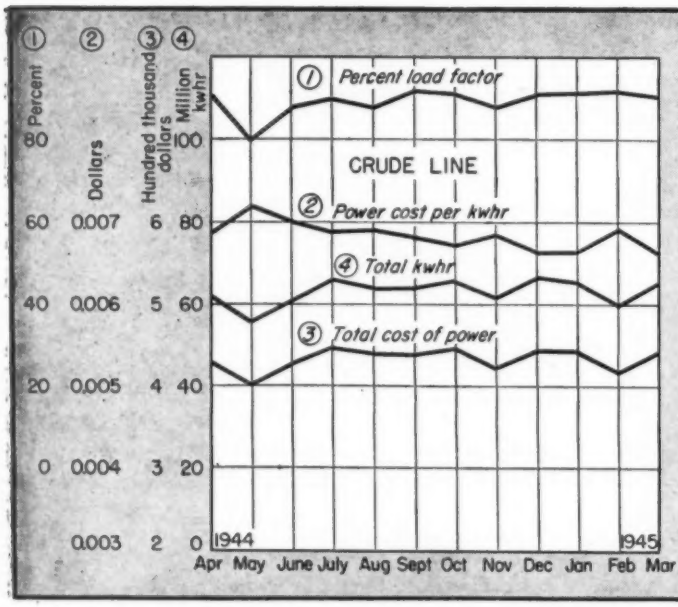


Fig. 4—Total monthly kilowatts, power costs and percent load factor for a year's operation of Big Inch crude line

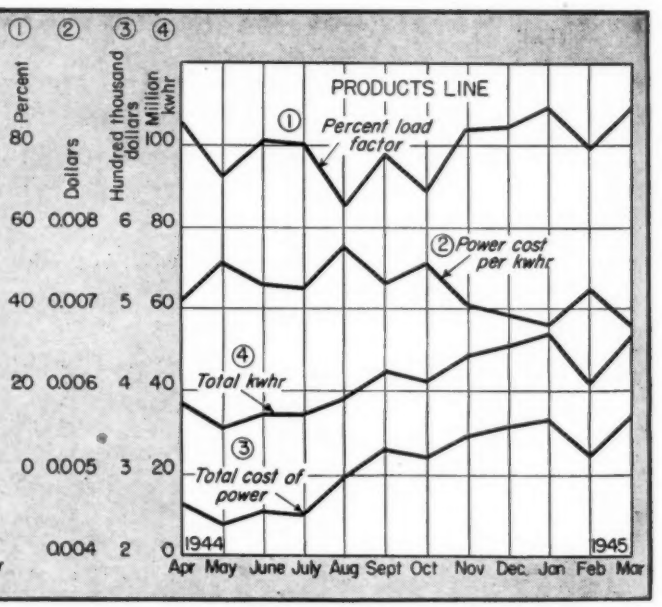


Fig. 5—Total monthly kilowatts, power costs and percent load factor for first year's operation of 20-in. products line

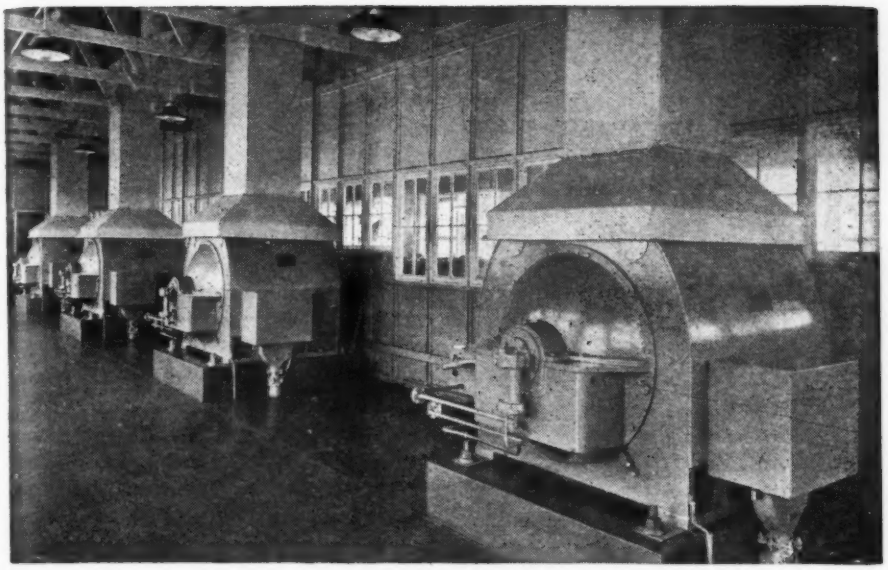


Fig. 3—Squirrel-cage induction motors rated 1250 hp, 3600 rpm are used to drive products pumps on the Little Big Inch. Firewall separates motors from pumproom

Fig. 10 shows the operating performance curves for the two lines combined. These curves give power factor, load factor, kilowatt-hours, cost of power and barrels of oil for each month for the first year of their operation together.

Both lines together pumped a total of 185,122,264 bbl of oil during their first full year's operation. Of this volume 112,456,166 bbl were pumped through the 24-in. crude line and 72,666,098 through the products line. This represented an average daily flow of 308,099 bbl through the crude line and 199,085 bbl through the products line. Total kilowatt-hours consumed to pump this oil was 1,282,729,624, which divides into 765,816,935 kwhr for the crude line and 516,912,689 for the products line. This rate averaged 2,098,128 and 1,420,089 kwhr daily for the 24- and 20-in. lines respectively. Power consumed for the year's operation cost $8,972,530, of which $5,247,965 was charged to the 24-in. crude line and $3,724,565 to the 20-in. products line. These amounts represent an average kilowatt-hour power cost of 4.67¢ per bbl of crude oil pumped and 5.13¢ per bbl of products pumped. Power was purchased at an average rate of 0.7¢ per kwhr, with a minimum rate of 0.47¢ per kwhr, and a maximum of 1.2¢.

Average load factors for the two lines were about 90% for the crude line and 80% for the products line. Although these load factors are very good on a yearly basis, considerably more than design flow was reached to maintain a yearly average near the designed rate.

Increased flow through the lines was accomplished in a variety of ways. A small increase was obtained when the hydraulic conditions of each line were balanced as nearly as possible. This was done by enlarging impellers in one or more of the pumps in stations where the discharge pressure was not high enough to keep the load from shifting to other stations. Enlarging impellers required increased horsepower and several of the motors on the 24-in. crude-oil line were rewound for 2000 hp. Where larger motors were not available the original motors were made to carry the load.

An increase in the 24-in. crude line resulted when the operating pressure was raised above 800 psi at each station east of Norris City, Ill. Increased power requirements for this change in pressure were met by raising the voltage so that full-load voltage at the stations was between 2400 and 2500. This allowed the motors to carry from 110 to 125% rated load without dangerously overheating. Line pressure on the 20-in. products line is limited to about 700 psi and subsequently controlled by the automatic discharge regulating valve; therefore, increasing the line pressure could not be used to increase the flow.

Because the pipeline is a series system a power failure or other interruption of

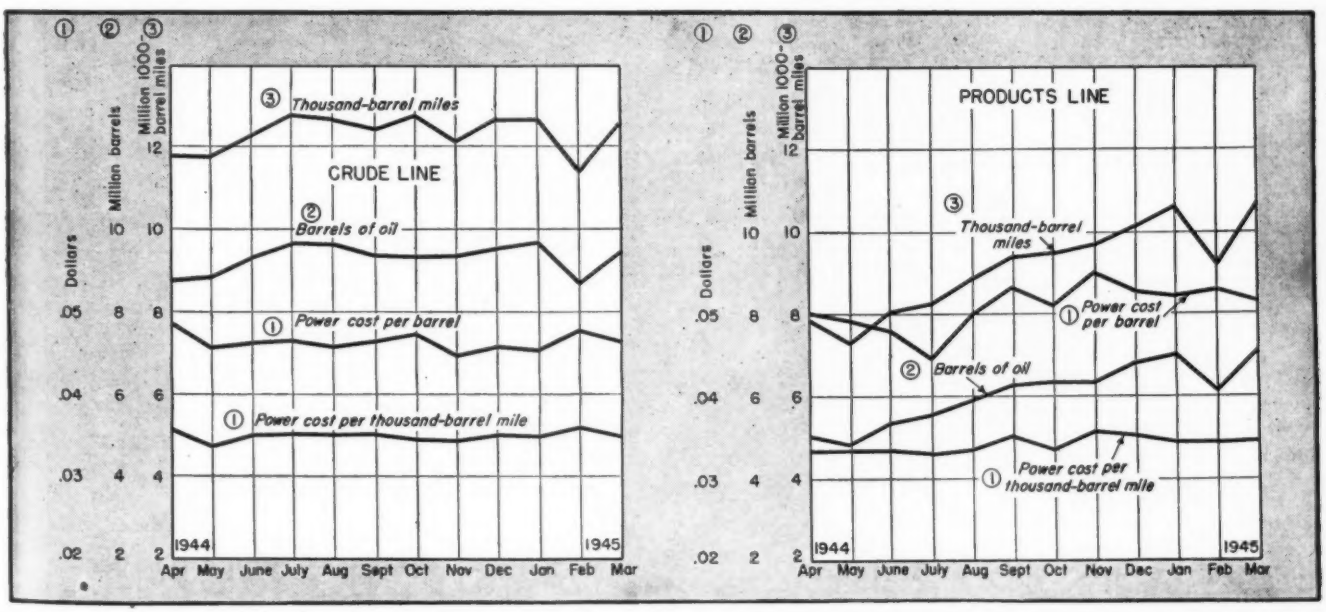


Fig. 6—Monthly barrels of oil, thousand-barrel miles and power costs per barrel for one year's operation of Big Inch

Fig. 7—Monthly barrels of gasoline, thousand-barrel miles and power costs per barrel, first year of Little Big Inch

any station operation results in a substantial reduction of pumping along the entire line. Reduction in through-put becomes accumulative if the pumps cannot be restarted shortly after they are stopped. Loss of a station will automatically result in shutting down the entire line if the flow is not reduced to the amount that can be pumped around the station until it is restarted. Each station is protected with a low-suction and high-discharge-pressure switch; therefore the line is shut down behind the station that is lost from high-line pressure and ahead from low suction. This process requires only a very few minutes and it is interesting to note that a pressure surge can travel the length of the pipeline and result in completely shutting down the line in 15 min, or less, if not checked by altering the pumping schedule.

A study of the power supply and electrical conditions was made to eliminate as much electrical down-time as possible. This was done by improving control systems in the stations and collaborating with the power companies for high-speed reclosing circuits after power interruptions. Transmission lines were also improved so that the switching units and other variations in operation or load would not interfere with station operations. Pumping in and out of tanks at Norris City, Ill., and Phoenixville, Pa., stations 11 and 25, respectively on the crude line reduced lost time by confining short interruptions to half sections of the system. Throttling action of the suction and discharge valves at the products stations furnishes some stabilizing effect on the 20-in. line.

Fig. 8—Control desk used to operate oil pumps in the 20-in. products station

Electrical construction and operation of these two pipelines were largely influenced and governed by wartime activities. This is especially noticeable in the lack of duplicate electrical feeders or auxiliary circuits which would improve operation continuity. Although the crude and products stations have separate switchyards and power transformers they do not have provisions for duplicate transmission lines or secondary feeder ties between stations. In spite of the lack of these conditions, the electric service was good and pump operation by electric motors dependable and satisfactory.

The wartime operation of these two pipelines has more than proved that the electrical operation of series systems, as long as these, can be made dependable although drawing power from several independent sources. Some of the outstanding advantages of electrical operation of such a system are: (1) lower initial investment (2) dependability of electric equipment (3) simplicity of operation and maintenance (4) adaptability to automatic and remote-control operation.

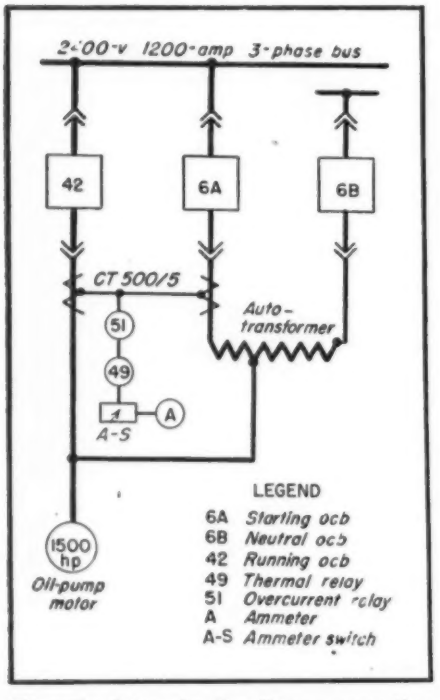
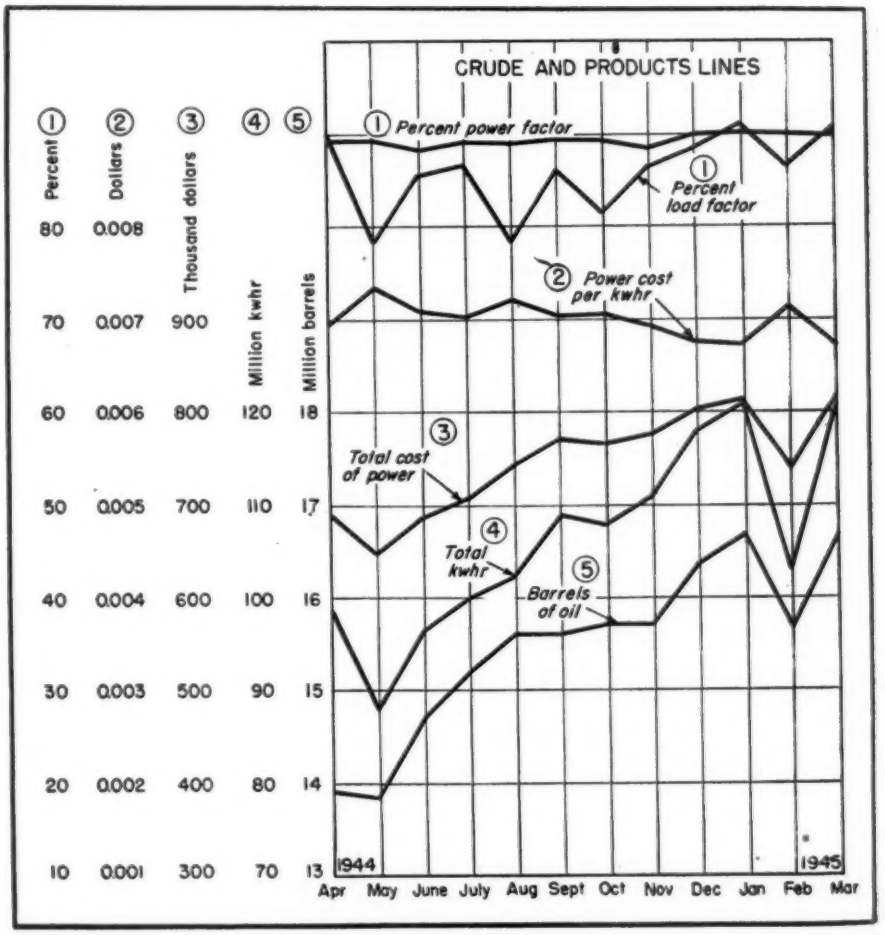


Fig. 9 (above)—One-line connection showing hookup of reduced-voltage starting for 1500-hp crude-oil pump motors on Big Inch. Where power supply was adequate reduced-voltage starting was changed to full-voltage. Fig. 10 (right)—Total monthly barrels of oil pumped, kilowatts, power costs, load and power factors are shown for Big Inch and Little Big Inch for their first full year


CRUDE AND PRODUCTS LINES
① Percent power factor
① Percent load factor
② Power cost per kwhr
③ Total cost of power
④ Total kwhr
⑤ Barrels of oil
① Percent
② Dollars
③ Thousand dollars
④ Million kwhr
⑤ Million barrels
80 0.008
70 0.007 900
60 0.006 800 120 18
50 0.005 700 110 17
40 0.004 600 100 16
30 0.003 500 90 15
20 0.002 400 80 14
10 0.001 300 70 13
1944
1945
Apr May June July Aug Sept Oct Nov Dec Jan Feb Mar

Condenser and Steam-Jet Air Ejector: A Team for Maintaining Exhaust Vacuum

Phil Freneau, ejector specialist, Worthington Pump and Machinery, in discussing joint operation of main steam condensers and their air ejectors and how to analyze individual performances, complements his articles on fundamentals of single and multistage air ejectors, June and July 1945, Power

► MAIN STEAM CONDENSERS and their air ejectors should be considered as closely related parts of vacuum systems rather than as independent pieces of equipment. Condensers maintain the highest vacuum consistent with flow and temperature conditions while their ejectors remove air and other noncondensables from the vacuum space by compressing them to atmospheric pressure.

Vacuum systems do not work properly if excessive noncondensables remain in the condenser or if excessive vapor quantities come over to the ejector. One piece of equipment can be partly analyzed by observing performance of the other. Certain condenser duties are checked customarily by using the ejector, which is considerably more flexible.

With stable operation, proper drainage and no interstage leakage the stage-characteristic curves of an air ejector predict the actual load for any absolute suction pressure. Variations in ejector load signify change in condenser operation or performance. Making simple adjustments of ejector settings demonstrates several facts about the vacuum system as a whole.

Steam from the turbine exhaust enters the main condenser and flows through the tube banks where it condenses. A small amount of air and noncondensable gas entrained with the steam comes from in-leakage, release from chemicals used in feedwater treatment and gas entrained in the makeup. Noncondensables flow with the steam through the tube bank and are removed by the ejector. To reduce the ejector-load moisture component the mixture is passed through a special air-cooling section either integral with or external to the main condenser. This section uses the coldest water available to reduce the mixture leaving-temperature to the lowest value.

Moisture present in the ejector load can be calculated from the following equation (for plot see POWER, May 1945, p 134, or *Mark's Handbook*, McGraw-Hill Book Co, 1941, p 313) derived from Dalton's Law and the characteristic gas equation:

$$W_m = W_a\left(1 + \frac{0.62P_v}{P_t - P_v}\right)$$

where W_m = weight of air plus water vapor to ejector, lb per hr; W_a = weight of dry air to ejector, lb per hr; P_v = partial vapor pressure in any pressure units; P_t = total mixture pressure in same units as P_v.

Determine: W_a from either an air meter* or an analysis of ejector performance, P_t by subtracting vacuum column reading from barometric reading, P_v from steam tables corresponding to mixture temperature. Difficulties arise in accurate measure of mixture temperature because of radiation and conduction effects causing large errors. True mixture temperature can more readily and accurately be found from the ejector capacity than

* Air meters normally read cfm of *saturated* air. This value must be converted to dry air at standard conditions.

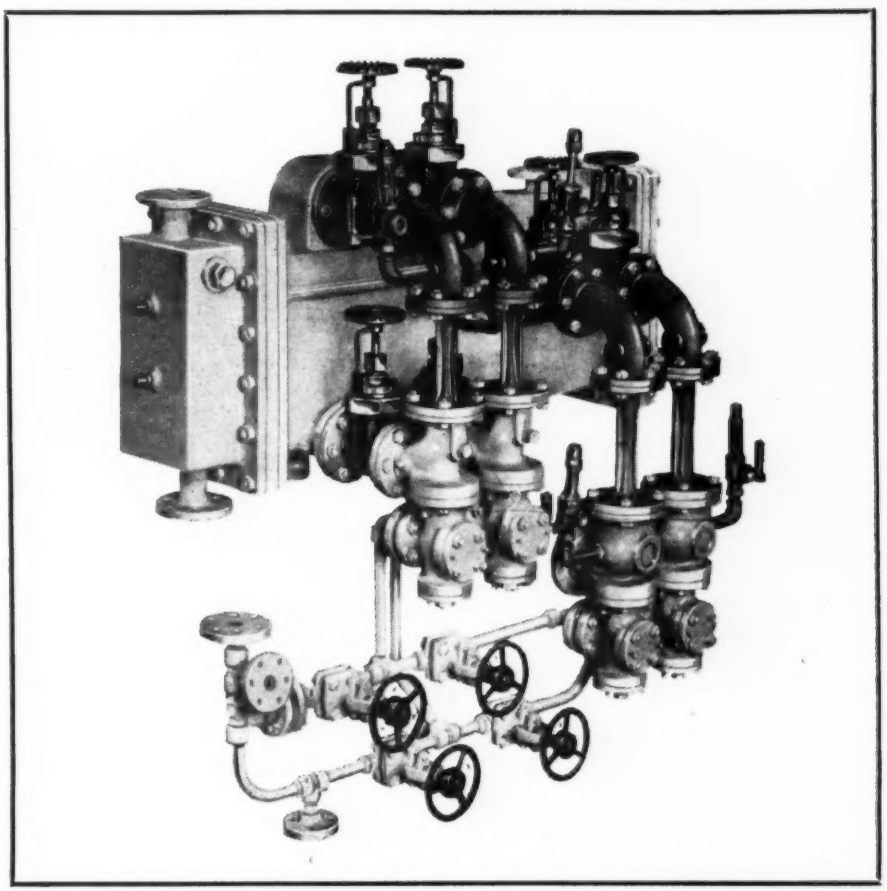


Fig. 1—Twin-element 2-stage steam-jet air ejector having performance characteristics outlined for each component in Fig. 3, 4 and 5. Pair of first-stage nozzle and diffuser assemblies right, with second-stage pair, left, and intercondensers and aftercondensers mounted in common shell, upper background. Condensers' inlet and outlet water box, left, motive steam piping and valves, lower left

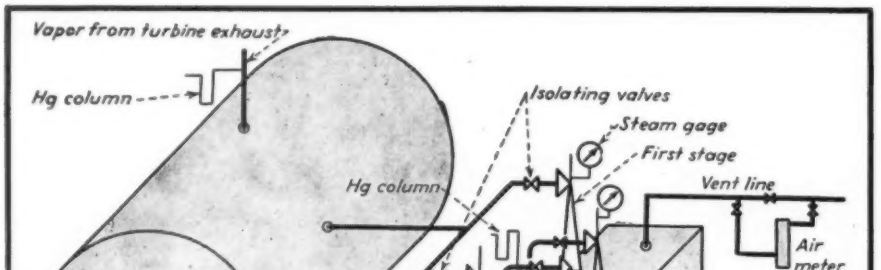


Fig. 2—Hookup of main condenser with 2-stage steam-jet air ejector showing instruments and valves required for control and checking of equipment performance

from the usual thermometer. From the above equation:

$$P_v = \frac{P_t W_v}{0.62 W_a + W_v} \text{ and } W_v = W_m - W_a$$

where W_a would be read from an accurate air meter and P_t from accurate mercury manometer at the ejector suction. Mixture temperature will be the value from the steam tables corresponding to P_v. The first-stage characteristic curve determines magnitude of W_m.

Mixture temperature indicates the air-cooling-section efficiency of the main condenser. Degree of subcooling is the difference between the temperature corresponding to absolute condenser pressure and the mixture true leaving-temperature. A decrease in subcooling for given turbine load and inlet-water temperature indicates reduced water flow to the air-cooling section or fouled tubes. Either condition calls for investigation.

Definition for degree of subcooling employs the term *true leaving-temperature*, which a study of condenser and ejector behavior explains. The air leakage to the vacuum system and the amount of noncondensables released from feedwater treatment are substantially constant. Load, circulating-water temperature and quantity, and tube-surface effectiveness determine the main-condenser absolute pressure. It is *not* a function of ejector capacity as long as this is at least adequate.

With these facts in mind consider the effect of increasing the turbine load while the other conditions remain constant. The absolute pressure in the main condenser will increase and the ejector can respond in two ways, either by pulling more vapor from the condenser or operating at an absolute pressure lower than expected, as a result of a pressure drop in the condenser. For stable operation of ejectors it has been shown (POWER, June 1945, pp 76-78; July 1945, pp 77-79) that they have a fixed capacity for each and every absolute pressure.

At the higher absolute suction pressures the ejector tries to obtain a greater load from the main condenser. As the noncondensable component is fixed this additional load can only be vapor pulled through the main condenser air-cooling section. If the baffles in the air cooler are tight this increased vapor flow causes a pressure drop. There is a similar drop in old-type condensers where the tube bank is too dense. If no pressure drop occurs the increased vapor load shows an apparent decrease in the degree of subcooling. Note that the excessive pressure drop or poor cooling is not a fault of condenser design but caused wholly by excess ejector capacity. Pressure drops or subcooling of these types are known as *apparent values* as distinguished from *true values*.

To determine true subcooling and true pressure drop connect mercury columns to the ejector and condenser sides of the ejector isolating valve as shown in Fig. 2. Throttle the isolating valve until the mercury column at the main condenser inlet starts to fall off. Read the condenser-side mercury column at the isolating valve and subtract this reading from the condenser-inlet value. This difference is the true condenser pressure drop.

Next read the mercury column on the isolating-valve ejector side, convert to absolute pressure and read the capacity on the first-stage characteristic curve corresponding to this pressure. This value is used for W_m in the formula. P_t is the pressure on the isolating-valve condenser side. Temperature corresponding to the pressure calculated for P_v is the true off-take temperature.

True pressure drops and subcooling vary with load and circulating water to the main condenser. If under identical operating conditions pressure drop or subcooling changes, some internal change in the main condenser has occurred, the reason for which should be found at the first opportunity. A slow decrease in subcooling is a sure sign of tube fouling.

Ejectors are customarily installed with considerably more than normal capacity to permit operation with abnormal noncondensable load or at very low absolute pressures. For this reason apparent subcooling or pressure drop appears unfavorable and the true values should be obtained to judge the equipment properly.

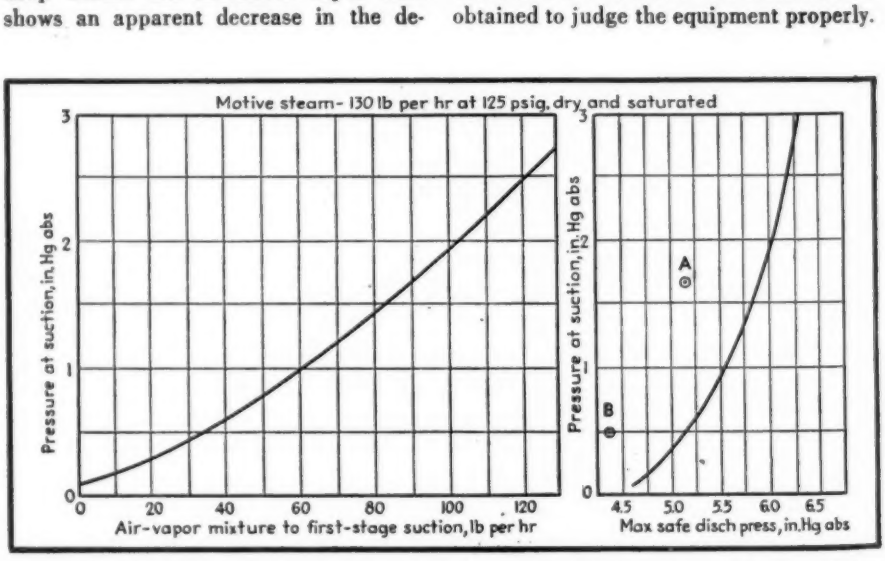

Motive steam- 130 lb per hr at 125 psig, dry and saturated
Pressure at suction, in. Hg abs
Air-vapor mixture to first-stage suction, lb per hr
Pressure at suction, in. Hg abs
A
B
Max safe disch press, in. Hg abs

Fig. 3—Performance curves of the first stage of a 2-stage steam-jet air ejector with twin elements. Points from the operating data show ejector operating stably

With twin-element units it is quite easy to produce high apparent values of pressure drop or subcooling by operating both sets of elements.

Both the vent and drains from the ejector are excellent telltales of system conditions. The ejector scavenges the major part of the gas from the system, the minor part being released from heater vent condensers. Excessive CO_2, O_2 or NH_3 is an indication of trouble in the feedwater supply. CO_2, NH_3 and air are normally detected at the vent. The drains may show excessive NH_4OH, phosphates or sulphates indicating improper feed treatment or changing conditions.

In no other part of the power plant do such appreciable concentrations occur. Design of ejector condensers determines whether drains or vent is the better indicator though both should be regularly checked. If the unit is designed to maintain the best heat balance the drains are considerably subcooled thus holding more gas in solution. If water conditions are bad the ejector condensers should be designed for higher drain temperatures to minimize gas solution.

Air Ejector Specification

Unless otherwise advised an ejector is normally designed for best heat balance. Such units when handling gas from bad water show badly contaminated drains, especially from the aftercondenser. Its drains are dumped to the sewer in some plants because the small amount of makeup wasted does not warrant expensive special feedwater treatment. Such plants should specify units designed for high drain temperatures. A device (patent applied for) is being developed which is expected to rid existing ejector drains of undesirable gas solutions in plants thus afflicted. It is hoped information on this device will be sufficiently condensed for publication in the near future.

A few typical examples illustrate ejector use as a performance indicator. Fig. 3, 4 and 5 show respectively performance

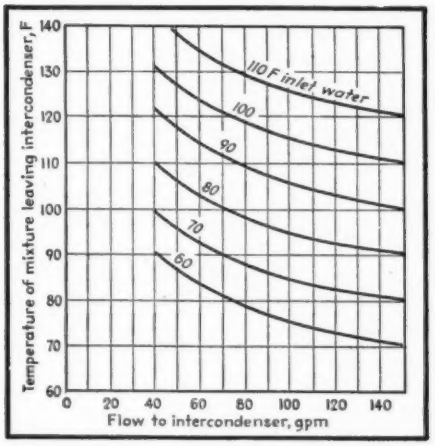


Fig. 4—Performance curves of the intercondenser for air ejector of Fig. 3

of first stage, intercondenser and second stage of a twin-element unit illustrated in Fig. 1. The stages are mounted on a common intercondenser and aftercondenser and are isolated by suitable valves and baffles. Each element is designed to compress 60 lb per hr of air-vapor mixture from 1-in.-Hg abs suction to atmospheric pressure. Air in the mixture is assumed to be not more than 18 lb per hr corresponding to the *standard* subcooling value recommended by the Heat Exchange Institute. Each element requires 240 lb per hr of motive steam at a pressure of 125 psig minimum, dry and saturated, divided into 130 lb per hr to the first stage and 110 lb per hr to the second stage. The ejector condensers require a minimum of 40 gpm at 80 F.

At normal condenser load with 70-F main-condenser circulating water the data of Table I were obtained. Since the motive steam pressure is safely above the minimum design value of 125 psig the maximum safe discharge-pressure curves of Fig. 3 and 5 apply conservatively. Previous aftercondenser vent discharge readings (not given) have shown maximum values of 0.3 in. Hg gage. Adding this to the barometer reading shows a second-stage system pressure of 30.26 to 30.31 in. Hg abs, which is well within the maximum safe discharge pressure of this stage of the ejector.

From the second-stage curve, Fig. 5, the air-vapor mixture is found to be 26 lb per hr corresponding to 5.2 in. Hg abs. Fig. 4 indicates the intercondenser offtake temperature for 96 F and 93 gpm is 112 F, and from the steam tables the corresponding vapor pressure is 2.76 in. Hg abs. Applying the basic equation to find W_a,

$$\frac{W_v}{W_a} = \frac{0.62 \times 2.76}{5.2 - 2.76} = 0.70$$

$$W_v = 0.70\, W_a$$

$$W_m = W_a + W_v$$

$$26 = W_a + 0.70\, W_a$$

$$W_a = 15.3 \text{ lb per hr}$$

First-stage system pressure is the second-stage suction pressure of 5.2 in. Hg abs. This value, labeled A on the first-stage maximum safe discharge-pressure curve Fig. 3, indicates the first stage as operating stably; the capacity corresponds to the suction pressure. Capacity corresponding to 1.69 in. Hg abs suction pressure is 89 lb per hr of air-vapor mixture of which 15.3 lb per hr is air and 73.7 lb per hr is water vapor. Apparent subcooling is then:

$$P_v = \frac{1.69 \times 73.7}{(0.62 \times 15.3) + 73.7} = 1.50 \text{ in. Hg abs}$$

From steam tables:
Temperature corresponding to 1.69 in. Hg = 95.6 F
Temperature corresponding to 1.50 in. Hg = 91.7 F
Apparent subcooling = 3.9 F

The valve in front of the first stage is now throttled until the vacuum reading at turbine exhaust falls off about 0.03 in. Hg. This throttling must be done very gradually as it takes an appreciable time for pressure equilibrium to be reached throughout the system. The reading on the condenser side of the valve is still 28.27 in. Hg with a barometer of 29.96. Second-stage suction reading is still 24.76 in. Hg but the outlet water temperature has dropped to 100.5 F with 96 F inlet and 92 gpm. Vacuum reading on the ejector side of the valve is now 29.16 in.

TABLE I—TEST DATA ON OPERATION OF MAIN CONDENSER AND AIR EJECTOR

Time	Inlet cooling water temp, F	Main condenser inlet pressure, in. Hg abs	Barometer, in. Hg abs	Motive steam pressure, psig: 1st stage	Motive steam pressure, psig: 2nd stage	Suction vacuum, in. Hg: 1st stage	Suction vacuum, in. Hg: 2nd stage	Suction pressure, in. Hg abs: 1st stage	Suction pressure, in. Hg abs: 2nd stage	Intercondenser: Inlet temp, F	Intercondenser: Outlet temp, F	Intercondenser: Flow, gpm	Remarks
Summer:													
10:00 am	70	1.71	30.01	130	131	28.32	24.81	1.69	5.20	96	101.3	93	Left-hand element in service.
12:00 am	70	1.71	30.00	128	129	28.30	24.79	1.70	5.21	96	101.5	95	Intercooler drain, 115 F.
2:00 pm	70	1.70	29.96	130	131	28.27	24.76	1.69	5.20	96	101.5	91	Will check cooling.
3:00 pm	70	1.72	29.96	130	131	29.16	24.76	0.80	5.20	96	100.5	92	Air meter reading, 4.0 cfm.
Winter:													
2:00 am	38	0.53	30.11	128	129	29.60	25.82	0.51	4.29	60	75.1	40	Right-hand element in service.
4:00 am	38	0.53	30.11	127	128	29.60	25.82	0.51	4.29	60	75.0	40	Will check cooling.
5:00 am	38	0.54	30.11	128	129	29.63	25.82	0.48	4.29	60	75.1	40	Air meter reading, 3.3 cfm.

Hg corresponding to an absolute pressure of 0.80. Corresponding weight of air-vapor mixture from Fig. 3 is 50 lb per hr.

As the second-stage reading has not changed, the air component must be the same, 15.3 lb per hr, and the vapor component equals (50 — 15.3) or 34.7 lb per hr. To find the true subcooling,

$$P_s = \frac{1.69 \times 34.7}{(0.62 \times 15.3) + 34.7} = 1.33 \text{ in. Hg abs}$$

From steam tables:
Temperature corresponding to 1.69 in. Hg = 95.6 F
Temperature corresponding to 1.33 in. Hg = 87.9 F

True subcooling = 7.7 F

Light-load winter operation shows somewhat different results as illustrated by the data for 38-F cooling water in Table I. The second-stage discharge pressure is now 30.41 in. Hg abs, which is still less than the maximum safe-discharge value shown in Fig. 5, and 21.5 lb per hr air-vapor mixture corresponds to the suction pressure of 4.29 in. Hg abs. From Fig. 4 for 40 gpm and 60-F water to intercondenser the second-stage mixture temperature is 91 F for which a corresponding pressure of 1.47 in. Hg abs is found from the steam tables. Then:

$$\frac{W_v}{W_a} = \frac{0.62 \times 1.47}{4.29 - 1.47} = 0.323$$
$$W_v = 0.323\, W_a$$
$$W_m = W_a + W_v$$
$$21.5 = W_a + 0.323\, W_a$$
$$W_a = 16.25 \text{ lb per hr}$$

From Fig. 3 for 0.51-in.-Hg abs pressure, weight of mixture entering first stage is 35 lb per hr; then vapor equals (35 — 16.25) or 18.75 lb per hr. Point B shows the system pressure under these conditions. Calculating apparent subcooling:

$$P_s = \frac{0.51 \times 18.75}{(0.62 \times 16.25) + 18.75} = 0.332 \text{ in. Hg abs}$$

Temperature corresponding to 0.51 in. Hg = 59.4 F
Temperature corresponding to 0.332 in. Hg = 47.7 F

Apparent subcooling = 11.7 F

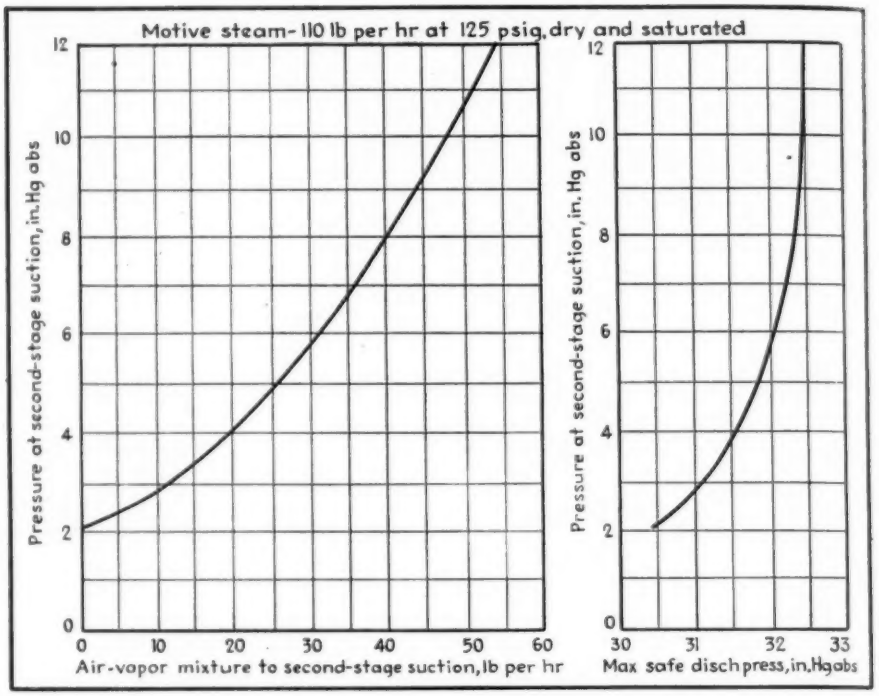

Motive steam- 110 lb per hr at 125 psig, dry and saturated
Pressure at second-stage suction, in. Hg abs
Air-vapor mixture to second-stage suction, lb per hr
Max safe disch press, in. Hg abs

Fig. 5—Second-stage performance curves of 2-stage steam-jet air ejector corresponding to curves for first stage, Fig. 3, and intercondenser curves, Fig. 4

Checking on the true subcooling shows that it is only possible to throttle 0.03 in. Hg before the main condenser inlet pressure is affected. The resulting mixture weight for 0.48 in. Hg abs is 33 lb per hr and the vapor weight is 33 — 16.25 = 16.75 lb per hr. Then the true subcooling is calculated as follows:

$$P_s = \frac{0.51 \times 16.75}{(0.62 \times 16.25) + 16.75} = 0.318 \text{ in. Hg abs}$$

Temperature corresponding to 0.51 in. Hg = 59.4 F
Temperature corresponding to 0.318 in. Hg = 46.5 F

True subcooling = 12.9 F

Note that the air release is slightly greater in winter because more of the turbine casing is under vacuum and gas absorption is greater with colder water. Air-meter readings show somewhat more than the actual air in summer and less than actual in winter because of the temperature-induced changes in air volume to the meter. If the meter design is satisfactory it is possible to correct the readings for temperature, thereby improving agreement between ejector and meter. One cubic foot of dry air per minute at 70 F and 30.00 in. Hg barometer equals 4.5 lb per hr of dry air. The examples show that true subcooling varies considerably with turbine load and main-condenser inlet-water temperature.

Abnormal conditions occur infrequently but as they are caused by radical system changes, plant personnel should be familiar with the indications, and the information ejectors can tell about the trouble. In general, abnormal vacuum conditions fall in three categories (1) The system does not prime. (2) The vacuum fluctuates at constant load. (3) The vacuum is lower than it should be.

Failure to prime or establish normal operating vacuum on starting is usually caused by insufficient motive steam to the second-stage nozzles or the evacuator. With single-boiler installations the turbines are frequently started before establishing normal operating pressures. If fixed orifices are used in the ejector steam line for reducing boiler pressure to ejector motive pressure level, insufficient steam flow results. Orifices should

(*Continued on page* 208)

TABLE II—POSSIBLE SOURCES OF AIR LEAKAGE With Increased Ejector Air Load

Excess-air leakage, lb per hr	*Relative audibility at source*	*Possible location of source*
1–10	Inaudible	Pump gland, turbine seal, cracked gasket, porous spot on turbine casing or condenser shell, relief-valve leak, leaking vacuum connection, leaking valve stem, leaking gage-glass packing
11–20	Slight	Open petcock, pump gland, turbine seal, cracked gasket, large porous spot, relief valve, crack about 1/64x2 in., open-vacuum gage connection
21–50	Fair	Wide open petcock, turbine drain under slight vacuum, pump gland, turbine seal, relief valve, valve stem, scale under seat of vacuum valve, cracked gasket, 1/8-in. pipe connection open, crack about 1/64x4 in.
51–100	Noticeable	Open turbine drain under slight vacuum, turbine seal, relief valve, valve stem, partially closed vacuum valve, gasket omitted, 1/4-in. pipe connection open, crack about 1/32x4 in.
100–500	Noisy	Hotwell gage glass broken, 3/8 or 1/2-in. pipe connection open, turbine drain open, open flange, turbine seal, crack about 1/4x2 in.
500–50000	Loud	Open flange, open pipe, large crack, no seal on low-pressure turbine glands

Note: Readings should be taken with stable ejector at or slightly above design steam pressure. If more than design steam pressure is required to obtain stability, either nozzles are clogged or nozzles and diffusers are badly worn.

Magnetic Drives

By F A ANNETT, Associate Editor

Power and industrial plants have recently applied magnetic drives so extensively that engineers should know the types, how they operate, where to apply them economically. Here are described construction, operation, applications and characteristics of magnetic clutches, electric couplings, variable-speed drives, speed-reducing and reversible magnetic drives

Magnetic drives may be divided into five general classes: (1) The magnetic clutch is a friction-disk design arranged to be closed and released by an electromagnet. (2) The electric or magnetic slip coupling is similar to an ac generator with its field poles mounted on the power-input shaft and its armature on the driven shaft. (3) The magnetic variable-speed drive is like 2, but is arranged to control output-shaft speed. (4) The speed-reducing drive has a fixed-speed ratio, such as 2:1, between input- and output-shaft speeds. (5) The reversible drive is arranged to reverse the direction of output shaft's rotation without affecting the input-shaft speed.

MAGNETIC CLUTCHES

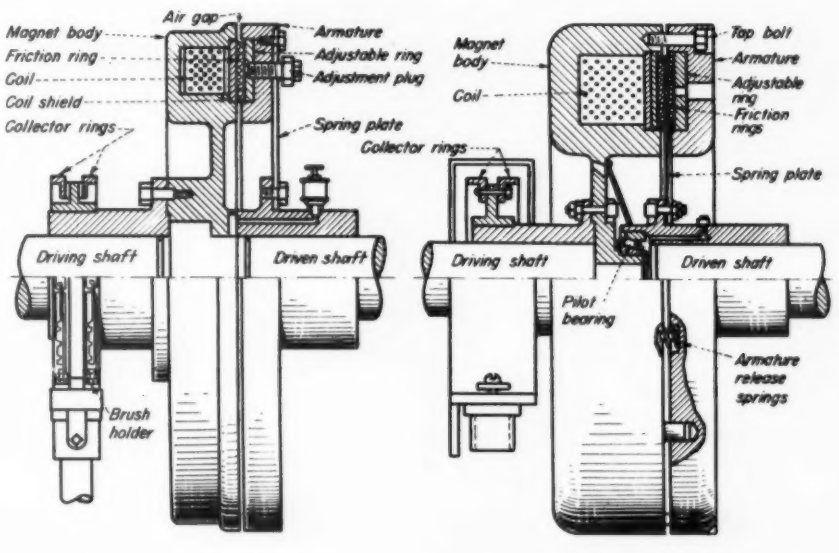
A magnetic clutch is a single- or multiple-disk friction clutch. It is operated by an electromagnet, which is energized by dc supplied through sliprings on the driving shaft. The electromagnet serves the same purpose as the operating mechanism on a friction clutch that is closed and opened mechanically.

A magnetic clutch is, however, not a true magnetic drive. Conversely, a magnetic drive is sometimes wrongly identified as a magnetic clutch. There is no connection between driving and driven elements of a magnetic drive as torque transmission depends on the slip between them.

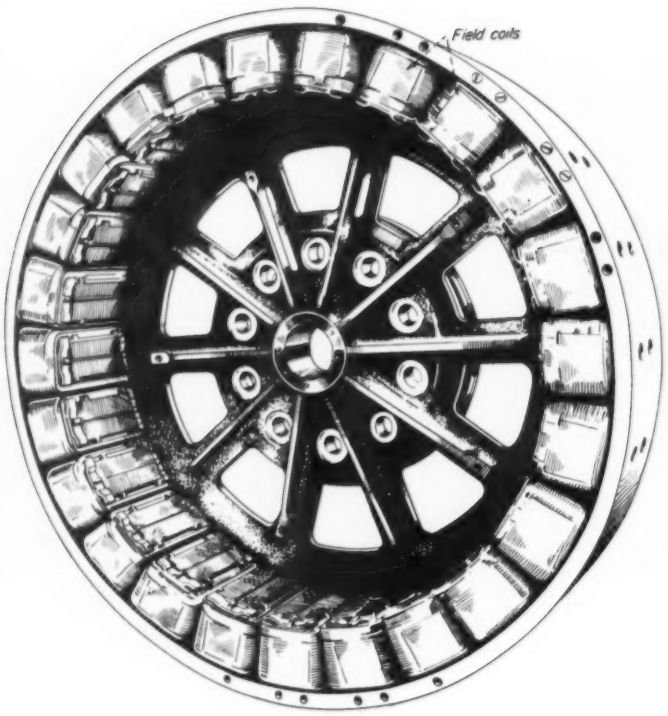
Fig. 1 shows a single-disk magnetic clutch with a single friction lining. Recessed in the steel magnet's body, the magnet coil is protected by a heavy cast-bronze ring that serves as a nonmagnetic shield. This part of the clutch is bolted to the driving hub, which also carries two sliprings to connect the coil to a dc source.

The magnet's armature is a flat steel ring into whose face an adjustable ring is recessed. Faced with friction material, the latter forms the friction element of the clutch. A spring plate bolted to the driven-shaft hub supports the armature with its friction element. This plate maintains a small clearance between driving and driven parts of the magnet when the coil is not energized. The magnet body then turns freely with the driving shaft when armature and driven shaft are at rest.

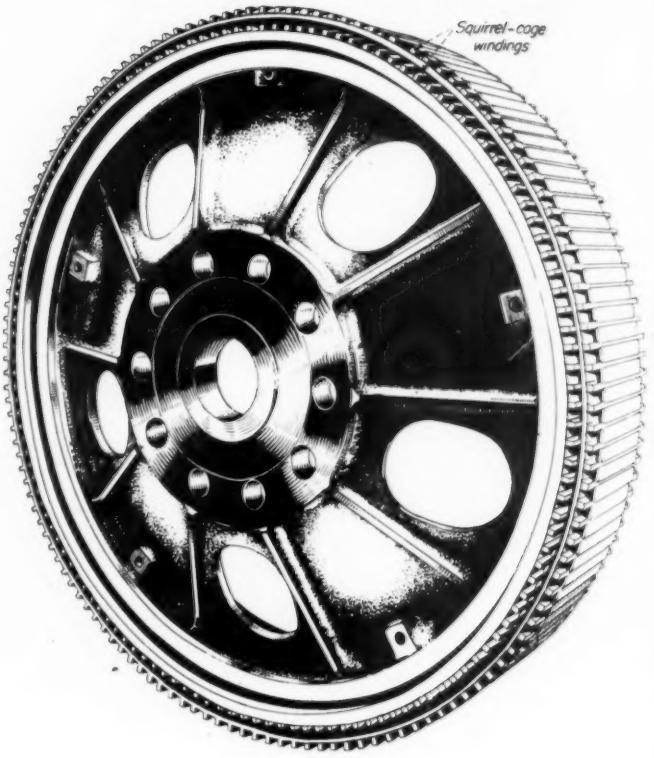
When the coil is energized it pulls the armature with its friction element tight-



1 Cross-section through a magnetic clutch with a single disk and friction lining. 2 *Right:* To increase the capacity for a given diameter and width, this single-disk magnetic clutch is constructed with a double friction surface



3 Outer member of a constant-speed electric coupling. Field poles are bolted to the inside of a steel ring and excited by dc



4 Inner member of constant-speed electric coupling. It has a double squirrel-cage winding in a slotted laminated-steel core

ly against the friction ring in the magnet body. Friction between the two parts transmits the driving torque to accelerate the driven shaft and bring it up to the same speed as the driving.

To increase the capacity of a magnetic clutch for a given diameter it is built in single- and multi-disk units that have a double-friction surface. Fig. 2 shows a cross-section through one design of single-disk clutch with a double-friction surface. Its magnet body with coil is bolted to the driving hub; the armature, being freely supported on tap bolts in the magnetic-body face, rotates with it.

A spring plate bolted to the driven hub supports a double-faced friction ring between coil shield and adjusting ring. Energizing the coil attracts the armature toward the magnet body to put pressure on the friction element and develop torque to accelerate the load.

Magnetic clutches are used as:

1. *Friction clutch:* To accelerate loads driven by low-starting-torque power units or to start high-inertia loads with a normally rated power drive.

2. *Positive-engagement coupling:* To synchronize the motion of two rotating drives, as on steel-mill screw-downs, flying shears, pinch rolls, etc. On some of these designs, friction surfaces are serrated to insure positive engagement.

3. *Slip coupling:* To slip at a predetermined torque, as on tapping machines and dredge pumps.

4. *Safety device:* To disconnect high-inertia loads for quick stopping when brakes are applied suddenly, as on rubber mills and printing-press drives.

5. *Frequent starting:* To start and stop loads when a motor has insufficient starting capacity for the application, and where starting power peaks must be kept down, as on an accumulator pump.

6. *Sectional drive:* To accelerate and lock one section of a machine with another, as on a Fourdrinier paper machine.

ELECTRIC COUPLINGS

In the electric or magnetic slip coupling there is no mechanical connection between driving and driven members. Torque is transmitted in the same way as from stator to rotor of an induction motor. In marine service between diesel engines and reduction gears that connect engine to propeller shaft, a typical application, such couplings act as follows: (1) Flexible coupling limits transmission of engine torsional vibration to the gears. (2) Disconnect clutch permits any engine in a group to be taken out of service. (3) Clutch not subject to wear can be quickly disconnected by opening the field current. (4) Coupling aids maneuvering. For example, some of the engines operate in one direction and some in the other. By energizing and deenergizing their electric couplings the propeller can be driven in either direction at will. (5) Flexible coupling can take a small amount of misalignment.

Electric couplings are also used to connect internal-combustion engines to their load to limit maximum torque impulses transmitted to the load and thus avoid stalling the engine. They may also be used to disconnect the engine, when too large for a friction clutch, before shifting gears.

Fig. 3 and 4 show the outer and inner members of one electric-coupling design. The outer member, Fig. 3, has field poles bolted to the inside of a steel rim mounted on a fabricated-steel spider. Field coils on the poles are dc energized. This part of the coupling is similar to the field structure of a dc machine. In this design the field poles are placed on the outer member to give more room for winding, provide better ventilation, and permit field coils to be easily replaced.

The inner member, Fig. 4, has a steel core made of one-piece circular punchings shrunk on the rim of a spider. This

core is slotted for a double squirrel-cage winding similar to that in a double squirrel-cage induction motor. One winding is placed above the other, each connected to separate short-circuiting end rings. The outer, or high-resistance, winding develops most of the torque during high-slip periods and is proportioned to absorb the heat then produced. The inner winding has comparatively low resistance and develops a large part of the torque during constant-speed operation at low slip. The core with its windings is supported on a fabricated spider that has a flange.

In most marine applications of electric couplings the inner member, Fig. 4, connects to the engine crankshaft. However, these couplings transmit torque between their two members in either direction so that the inner or outer one may be connected to the engine shaft, depending largely upon the amount of inertia (flywheel effect) needed for satisfactory engine operation.

Coupling Operation

An electric coupling may be considered as a generator with its armature coils short circuited, combined with a motor. With the engine running, the inner member (armature) of the coupling rotates inside the outer member, but as long as the field poles are not excited torque is not transmitted. Energizing the field coils excites the field poles to generate a current in the armature's conductors. This current reacts on the field-pole flux producing a torque, as in a dc or an induction motor, to start and accelerate the load.

Driven member of the coupling must operate at a slightly slower speed than the driving to generate the necessary current for torque production. Difference in speed between the two is similar to the slip between rotor and stator of an induction motor, and serves the same purpose. This slip varies with the torque transmitted by the coupling but is usually between 1 and 3% at normal load. That is, the driven member operates at a speed 1 to 3% less than the driving.

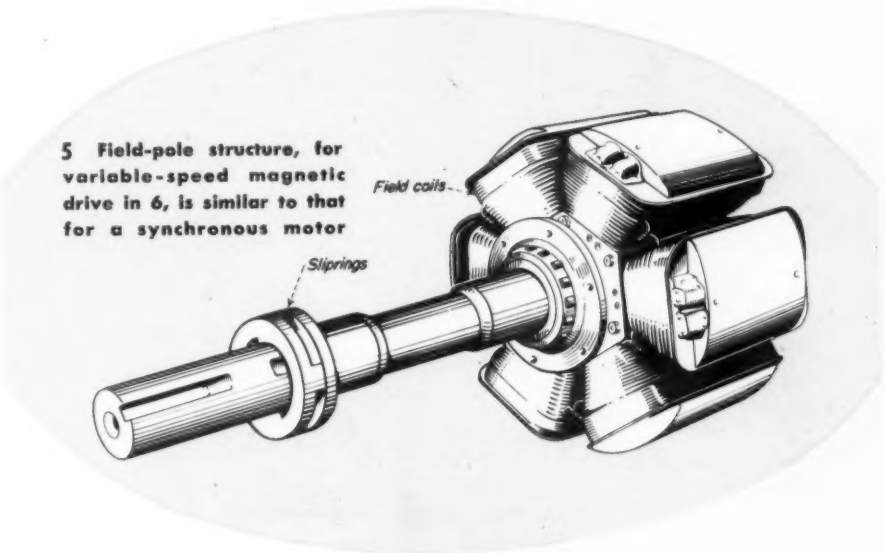
To obtain variable-speed the armature winding can be insulated and leads brought out from it to sliprings as in a wound-rotor induction motor. Speed is then controlled by external resistance as with a wound-rotor motor. For certain types of load a variable-speed coupling can be designed with a high-slip squirrel-cage winding and its output speed controlled by regulating the excitation. This is analogous to controlling speed by adjusting the voltage to the stator winding of a squirrel-cage induction motor. However, variable speed with magnetic couplings is usually obtained as described in the following paragraphs.

VARIABLE-SPEED DRIVE DESIGNS

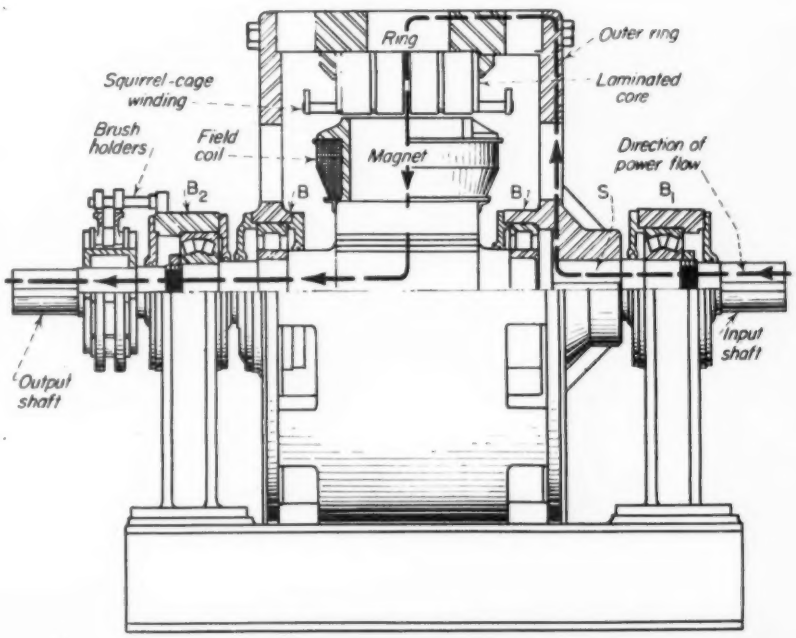
The several designs of magnetic variable-speed drive that have been developed are essentially the same as those in Fig. 3 and 4. However, they generally have their field poles on the inner member and the squirrel-cage winding with its laminated core on the outer. The variable-speed drive usually has only a single squirrel-cage winding, as compared to the double winding in Fig. 4. In other designs an eddy-current ring replaces the laminated core and squirrel-cage winding.

Fig. 6 shows a cross-section through one design of a variable-speed magnetic drive. It is a magnetic slip coupling with a field-pole structure, Fig. 5, like that in a synchronous motor, or ac generator, but does not have a damping winding in its pole faces. An outer ring, Fig. 7, has a circular steel back-plate in which is clamped a laminated-steel core, slotted on its inner periphery for a single squirrel-cage winding. This core and its winding are like the rotor of a squirrel-cage motor except they are adapted to form the outer rotating member of a variable-speed magnetic drive.

In Fig. 6 two bearings, B, support the outer ring so that it can rotate freely about the field poles. On the right, the ring and field-pole assembly is supported by stub shaft S fixed in the ring frame and carried in bearing B_1. On the left,



5 Field-pole structure, for variable-speed magnetic drive in 6, is similar to that for a synchronous motor



6 When field coils are excited with dc, current generated in the squirrel-cage winding produces a torque in proportion to the field-magnet excitation

the ring is supported by the field-pole shaft in bearing B_2.

With this bearing arrangement, the drive's field-pole element can be held stationary while the ring with its core and winding rotate about it on bearings B, B and B_1. For exciting the field-pole coils, dc is supplied through two collector rings from a dc bus, from an exciter driven by the power-unit shaft, or from an ac source through a rectifier.

The ring shaft couples to the power unit, usually an induction or a synchronous motor, and operates at constant speed. Coupled to the load, the magnet shaft rotates at a speed determined by slip between ring and magnet. This slip is controlled by amount of current permitted to flow in the magnet coils, by an adjustable rheostat or by an electronic-control system.

If the power unit is started and brought up to speed without excitation in the field coils the ring rotates, but the field-pole structure and load remain at rest. Applying excitation produces a flux in the magnet circuits formed by the field poles and the laminated core in the ring. This flux generates electric currents in the squirrel-cage winding in the same way that currents are induced in an induction-motor rotor's squirrel-cage winding. These induced currents produce a magnetic flux in the ring, which reacts on the flux of the magnet to pull it around with the rotating ring.

Torque transmitted from driving to driven member depends on the current in the field coils and the slip between ring and magnet. With rated load connected to the output shaft and full excitation in the field coils, full-load torque is transmitted at 5 to 2% slip, but can be made less if desired. That is, when the field poles are running 5 to 2% slower than the ring, enough current is generated in the squirrel-cage winding of the input member to develop full-load torque.

Speed Control

Decreasing the current in the field coils reduces the magnetic flux; consequently the slip must increase between field poles and ring to generate enough current in the squirrel-cage winding to transmit a given torque. The smaller the field current, the slower the speed at which the field poles and output shaft rotate.

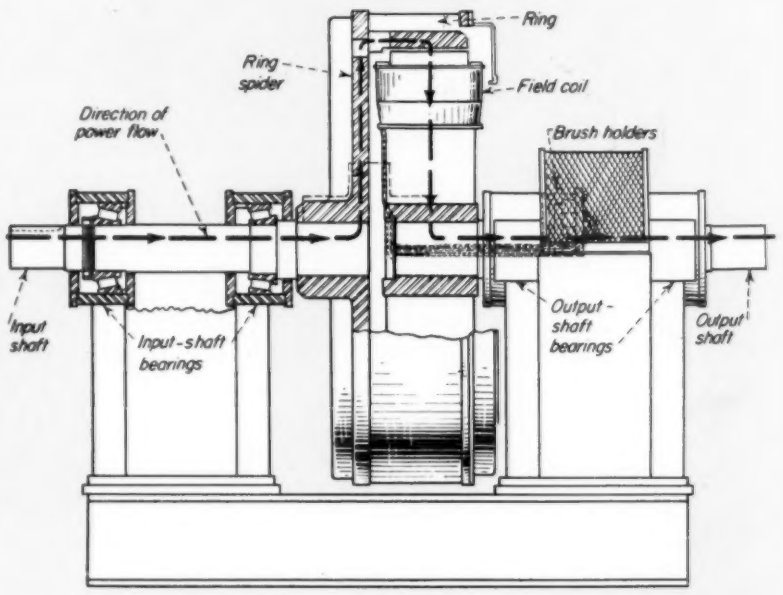
The design in Fig. 6 is generally used for large-sized drives. Smaller-sized units are built without a laminated core and squirrel-cage winding in their input member. Instead, they have a solid-steel core ring, Fig. 8, in which induced currents circulate much the same as in the bars of the squirrel-cage winding, Fig. 6. Operation of the two designs is practically the same.

Ventilation of the ring is not quite so good as in the squirrel-cage type. Therefore the former is limited to about 300 hp, whereas the latter can be built for several-thousand horsepower. In the design of Fig. 8 both input and output elements are independently supported in two roller bearings instead of having the bearing arrangement in Fig. 6.

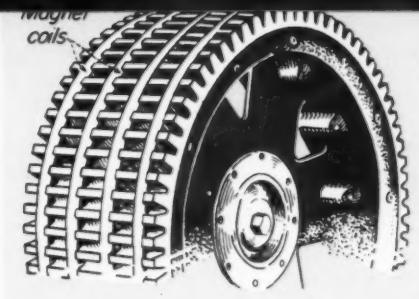
Magnetic drives are usually applied to speed control of large fans, centrifugal pumps and similar loads. Fig. 12 shows the performance of a variable-speed coupling when driving a fan or blower. With this class of load, torque varies as the square of the speed, and power as its cube. Because of this characteristic, load drops rapidly with speed as indicated by the blower-power curve. For example, the blower requires 100% power at about 97% motor speed, but at 50% speed power drops to about 12.5%, or ⅛ that at full speed, point *A*. This rapid decrease in power with speed keeps the total losses (slip, excitation and windage) low in the coupling. With a fan or blower load the losses reach a maximum of about 16% at about 65% full speed, point *B*. At blower speeds below 65%, total losses decrease until at 30% speed they drop to about 8%, point *C*.

Slip-loss characteristic of a magnetic drive is inherently that of all other torque transmitters operating on a slip principle. It even occurs with a slip-ring motor when its speed is reduced by connecting resistance in series with its rotor windings. These losses are dis-

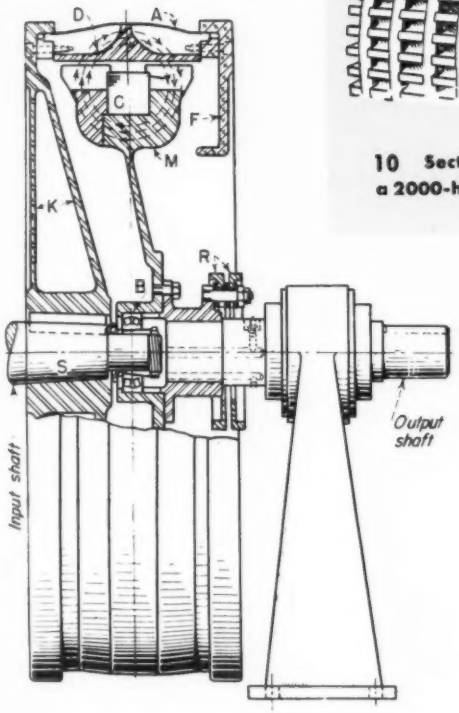
7 Outer ring, for a variable-speed drive, 6, has a circular slotted core of laminated steel



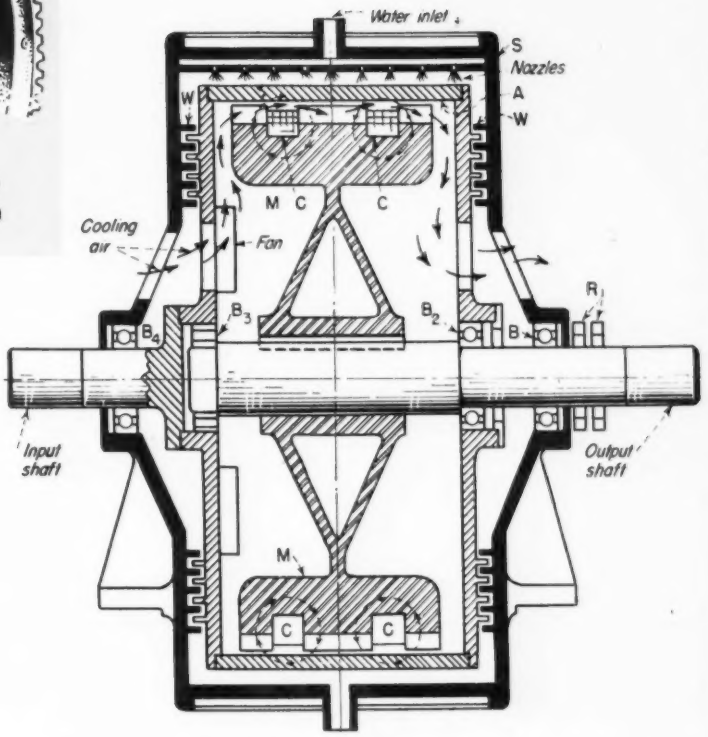
8 Smaller sizes of magnetic drives, 6, use solid-steel core ring in which induced currents circulate much as in the bars of a squirrel-cage winding



10 Section of field poles for a 2000-hp eddy-current coupling



9 Cross-section through an air-cooled eddy-current type of variable-speed coupling



11 Large-sized variable-speed eddy-current couplings are water cooled to obtain increased capacity for given over-all dimensions

sipated as heat, but no external cooling device is required. The ring, with its laminated core and squirrel-cage winding, revolves at full motor speed, making it practicable for this part of the drive to be self-cooled effectively. The field-pole structure may operate at slow speeds, but reduced field-coil current compensates for reduced ventilation.

Eddy-Current Couplings

Fig. 9 and 11 show eddy-current variable-speed magnetic drives. The design in Fig. 9 is air cooled, while the one in Fig. 11 is water cooled. The former includes eddy-current armature ring *D* and single-coil magnet *M*.

Armature ring *D* is made of a specially treated magnetic steel that produces strong eddy currents, which are always nearly in phase with the magnetic poles. This ring is first made solid, and then closely spaced fins *A* are formed in its outer surface by cutting a series of slots towards the ring's center. These fins carry magnetic flux across the outer part of the ring and serve to radiate heat from it caused by eddy currents generated in the ring. A skirt, or flange, *F* on the ring's right-hand edge properly directs air to cool the fins. On its left-hand edge armature ring *D* is supported by twin disk *K* on the driving shaft *S*.

The drive's inner member consists of ring magnet *M* with a peripheral slot in the center in which is wound single coil *C*; excitation is supplied through brushes on two sliprings, *R*. Outer surface of the magnet has slots that look like gear teeth, Fig. 10. They are the magnetic pole pieces in whose ends high-flux density is obtained to improve the drive's torque characteristics. The dotted rings, Fig. 9, indicate path of magnetic flux through the magnet and its poles and the fins in the armature ring.

A self-aligning spherical roller bearing *B* on the end of the input shaft supports the magnet and its coil. The vertical center line of the ring armature and magnet passes through the center of this bearing to balance the forces acting between the driving and driven members; a thrust bearing is not required between the two. The driven shaft attached to the magnet may be supported in an outboard pedestal bearing, as in Fig. 9, or connected to the driven unit's shaft by a piloted coupling.

Only difference between the designs of the water- and the air-cooled eddy-current couplings is in construction details. The water-cooled design, Fig. 11, has two coils, *C*, on field magnet *M* that, when excited, produce a magnetic field in the direction indicated by dotted circles around the coils. Field magnets in large couplings may have four, or more, field coils, Fig. 10.

Armature *A* is a special metal drum rotating in a chamber or shell *S* that is supported on a baseplate. This shell is stationary and carries parts of two labyrinth water seals, *W*, that mesh with a corresponding part on the drum supports. These seals prevent cooling water running toward the shaft, and centrifugal force of the rotating-drum supports normally throws the water to the shell's inner surface. Water piped to nozzles in the shell's top is sprayed onto the armature drum for the primary cooling.

Air-Cooled Magnet

In addition to water cooling on the outside of the armature drum, air is drawn in by a fan through its left-hand support, forced over the field magnet's periphery and out through openings on the right-hand side of the armature support and housing to cool the magnet and its coils. This air also helps to cool the armature.

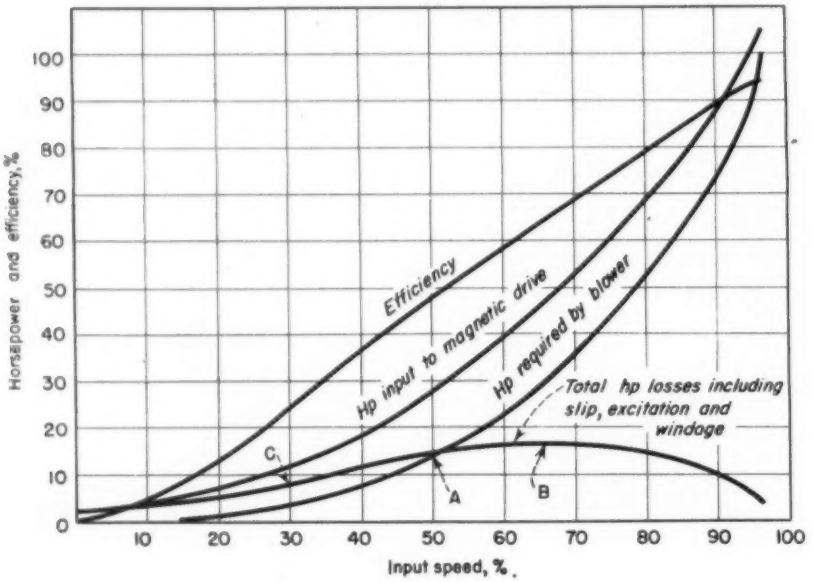
In Fig. 11 the field magnet is mounted on the variable-speed output shaft and supported by two bearings, B_2 and B_3,

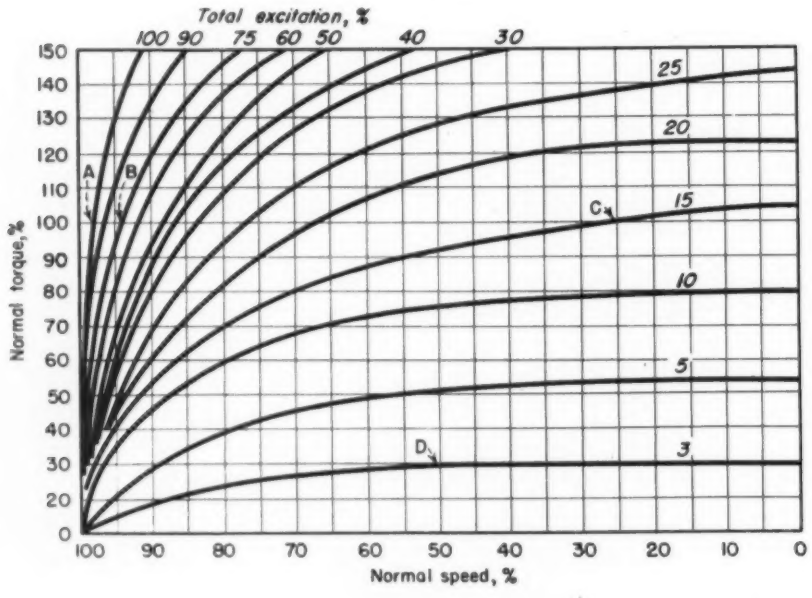
in the armature drum. The field magnet and armature drum are, in turn, carried in bearings B and B_4 in the shell. This arrangement of bearings permits the armature and field magnets to rotate independently of each other. Sliprings R for field-coil excitation are on the variable-speed shaft outside the shell. Leads from these rings to the field coils run either through the shaft or through grooves in its outer periphery.

Operating principle of air- and water-cooled couplings is the same. A difference in speed between the armature ring D and the field magnet M, Fig. 9, generates eddy currents in armature drum D. These currents react on the magnetic flux to produce torque in the same way that the currents in the squirrel-cage windings of the other designs developed torque. When transmitting normally rated torque in most commercial applications, slip between armature and field is from 1.5 to 3.5% with rated field-coil excitation. But slips can be made as low as 1% where conditions require, and drive size is not limited.

Output speed of an eddy-current magnetic drive is adjusted by changing its field current. Fig 13 shows the torque characteristics of such a drive with different percentages of normal-excitation current in the field coils. With 100% excitation, 100% normal torque is obtained at about 2% slip, point A. This means that the output magnet runs at about 98% armature-drum speed. With field-coil excitation reduced to 75% of normal, 100% normal torque is obtained at 6% slip, point B. At 15% excitation, 100% torque is obtained at 75% slip, point C. That is, output speed is 25% of input speed. Reducing the excitation to the low value of 3%, coupling torque drops to 30% at 50% slip, point D. All of these curves have a gradually rising characteristic, which shows that the drive is stable at all points in its speed and load range.

Response to change in torque requirements is practically instantaneous. Any change in excitation current is immediately translated into a change in the drive's torque and speed. Time required to change from zero to full torque is about 2 to 3 sec. To translate a smaller change in field current to a corresponding change in torque requires less than 2 sec. This does not mean that a blower's speed changes from zero to full speed in 2 sec, because inertia of the rotating element influences the rate of speed change. Normal installations from 500- to 1200-hp rating can be, if necessary, accelerated from standstill to substantially full speed in about 1 min.





12 ***Above:*** **Performance curves of variable-speed magnetic drive when driving a fan or blower. Maximum loss, about 16%, occurs at 65% full speed.**
13 ***Below:*** **Torque characteristics of a variable-speed eddy-current coupling with different percentages of normal excitation current in its field coils**

Output Speed Range

Speed range of the drive is practically infinite. That is, a 1200-rpm coupling operates at any speed down to 100 rpm continuously when driving a blower. Were it not for the slight windage effect between the two rotating members, causing a blower to crawl slowly when the drive motor is running, speed could be controlled from zero to full value. When the coupling drives a constant-torque load, or one with high friction, the coupling can control output speed from zero to full value.

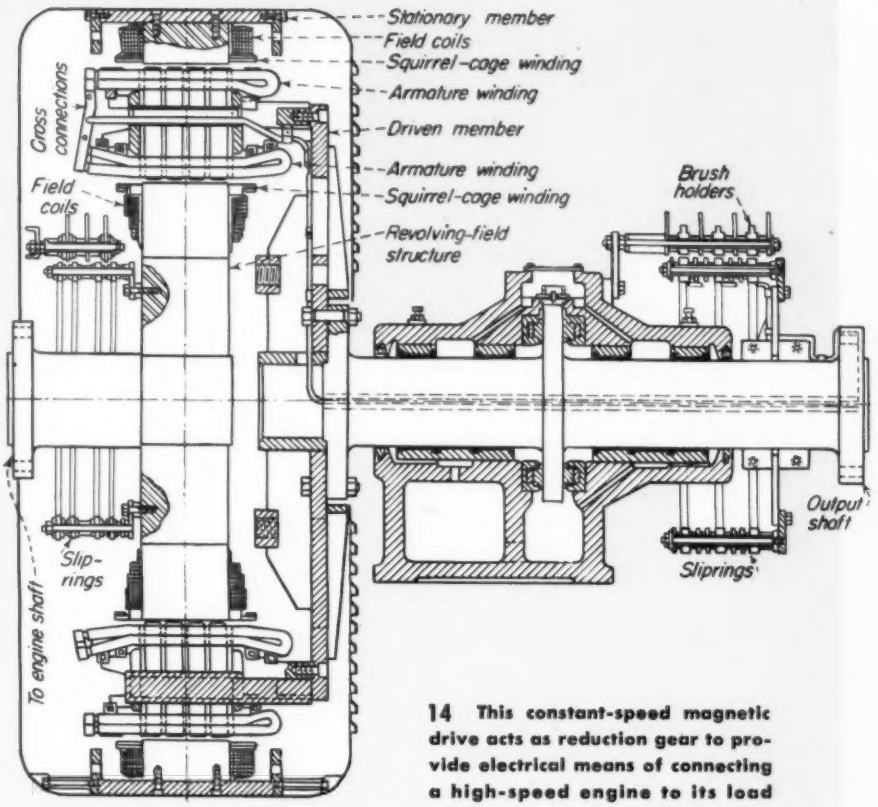
Eddy-current couplings have a wide variety of applications: (1) to run fans and pumps in power plants (2) to drive refrigeration compressors to air-condition railway cars (3) as absorption dynamometers, to test engines and other prime movers (4) to drive centrifugal machinery, large electric shovels, punch presses and wind-tunnel fans—one of the latter is rated 18,000 hp. An interesting application is designed to feed electric power back into the manufacturing plant's power system when testing diesel or aircraft engines.

SPEED-REDUCING DRIVE UNIT

A recent member of the magnetic-drive family, the speed-reducing drive, acts as a reduction gear, a flexible coupling and a load-starting device. Known as a Bowes drive, it provides an electrical means of adapting high-speed engines to low-speed applications. For ship propulsion, it reduces engine speed to that required for efficient propeller design. This drive maintains a constant-speed ratio between driving and driven members without a mechanical connection between the two.

Fig. 14 shows a cross-section through a Bowes drive. It consists of (1) driving member (2) driven member and (3) stationary member.

The first, the revolving-field structure of a synchronous generator, has a squirrel-cage winding in its pole faces like a synchronous motor. This member connects directly to the engine shaft and has sliprings for field-coil excitation.



14 This constant-speed magnetic drive acts as reduction gear to provide electrical means of connecting a high-speed engine to its load

Driven Member

The driven member connects directly to the driven shaft and serves the double purpose of an armature of a synchronous generator and of a synchronous motor. It has a fabricated-steel structure that supports a laminated-steel core slotted on its inner and outer periphery. Each set of slots contains the coils of an ac armature winding. In the inner periphery of the core, the coils operate in conjunction with the field poles connected to the engine shaft as a synchronous generator. Terminals of this winding connect directly to a similar winding in slots in the laminated core's outer periphery. This winding serves as the armature of a synchronous motor, supplied with power from the inside armature winding.

A cylindrical steel ring supported by feet bolted to the main foundation carries the stationary member. Salient poles with field coils, like those on the driving member, connect to the inside of the stationary ring. These pole pieces have a squirrel-cage winding in their faces, like the poles on the input member, and operate in conjunction with the armature winding on the outside of the driven member to form a synchronous motor.

This drive may be considered as two separate units, a synchronous generator and a synchronous motor. Assume that the drive is designed for its input member to connect to a 240-rpm diesel engine and that its output shaft couples to a 120-rpm propeller, which gives a speed ratio of 2:1 between driving and driven shafts. The engine is started and run at maneuvering speed of about 100 rpm, while the output member and the propeller remain stationary.

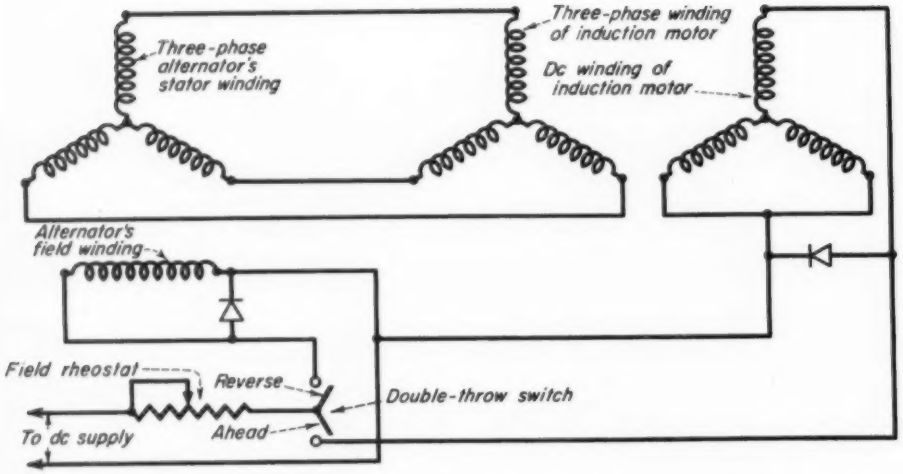
Field coils of the engine-driven member are now energized to excite the field poles. The magnetic field from these poles acts on the inside armature winding of the output member to generate ac power. Reactive torque between field poles and armature causes the latter to rotate. At the same time current generated in the inner armature winding flows through the outer one to produce a rotating magnetic field. This field generates a current in the squirrel-cage winding of the stationary pole-pieces that reacts on the rotating field, as in a synchronous motor, to produce another torque and help accelerate the output members.

The engine member still runs at 100 rpm as the output member gains in speed. Therefore, the difference in speed between engine and output member is decreasing, causing a decrease in generated power frequency. At the same time the speed of the output member relative to the stationary one is increasing. This means that the synchronous motor is approaching its synchronous speed, which is directly proportional to applied frequency coming from the generator winding.

When the output member is operating at nearly half engine speed, 50 rpm, synchronous-motor speed about corresponds to decreased generator frequency. At this point excitation current is applied to the stationary-field coils. The synchronous motor part of the drive has been accelerating as an induction motor on the squirrel-cage winding in the faces of the stationary-field poles. As such, the motor has reached a speed just below synchronism (about 47 rpm in this case) and will pull into step at 50 rpm when excitation is applied to the stationary-field coils.

Input member is now running at 100 rpm, output member at 50 rpm, and stationary member 0 rpm. Consequently, difference in speed between the generator-field input member and generator armature on the output shaft is 50 rpm; and between the motor armature on the output shaft and the stationary field poles, 50 rpm also. The two units are now locked in step and engine speed may be changed as desired with the output-shaft speed changing in proportion to maintain a constant 2:1 speed ratio.

This ratio is designed into the drive by proper selection of the number of poles in the generator and motor parts of the unit. For other speed ratios, the number of field poles must be changed to suit the desired speeds.



15 Diagram of reversible magnetic drive that includes a synchronous alternator and an induction motor, as shown in 16. The motor has two distributed field windings

REVERSIBLE DRIVES

A cross-section of a reversible magnetic drive described in *Engineering* (London) Oct. 17, 1941, is shown in Fig. 16. It consists of an alternator and a magnetic coupling, the equivalent of an induction motor. The alternator's field poles *P* and the rotor *R* of the induction motor are fixed to the input shaft. The alternator's stator is supported in a frame bolted to the unit's bedplate. Field core and windings *W* for the induction motor are mounted on a spider keyed to the output shaft. This core is slotted on its outer periphery and has two 3-phase star-connected windings. For one direction of rotation one winding is excited by dc, and for the other direction the other winding is excited by 3-phase ac, as indicated in Fig. 15.

For the output shaft to operate in the same direction as the input one, and at practically the same speed, the power unit is started and brought up to about half speed. Then, excitation is applied to the magnetic drive's dc winding, which produces magnetic poles in core *W* as with a salient-pole winding. As the squirrel-cage winding in core *R* rotates through the magnetic field, current is generated in it that reacts on the latter to produce torque as in an induction motor. This torque accelerates the output shaft in the same direction and up to about the same speed as the input shaft. In this direction of rotation, operation is the same as for the other 2-element magnetic drives described previously, the alternator remaining inactive.

For reverse direction of the drive, the dc winding of the induction motor is disconnected, the alternator's field excited and its windings connected to the ac winding on the induction motor's rotor. Current from the alternator is generated at a frequency that produces a rotating magnetic field in the induction motor's rotor of twice the speed of the input shaft and in the opposite direction. This is necessary for reverse rotation, since mechanically the outer member of the magnetic coupling continues to rotate at input speed. A reverse magnetic field of twice input speed imposed on this motion then results in a reversed field of normal speed so that the output shaft runs at normal speed in reverse direction.

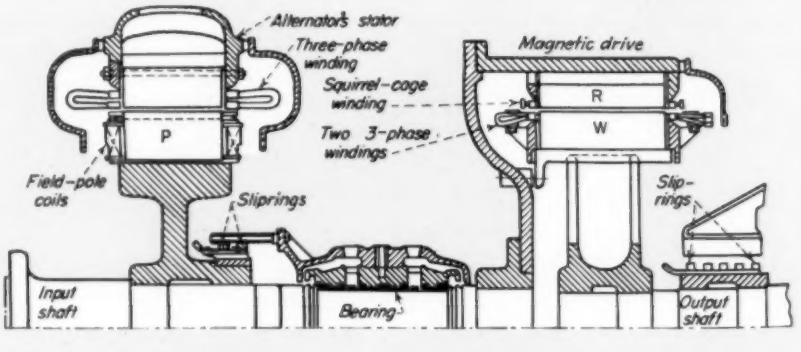
If the outer member connected to the input shaft has ten poles and is driven at 300 rpm when excited with dc, it produces a 25-cycle forward-rotating magnetic field. To generate a corresponding field in reverse direction it is necessary to apply a 50-cycle rotating magnetic field in relation to the outer member. However, owing to the forward rotation of the outer member, the over-all effect relative to the rotor is a 25-cycle reverse field and a corresponding speed.

Mechanically the coupling elements may be arranged in different ways. For simplicity the alternator has been shown separate from the magnetic coupling, but a commoner arrangement is a combination of the two in a single unit. This drive may be considered as a normal magnetic coupling in which an alternator on the input shaft supplies an induction motor on the output shaft. However, it has the advantage that the alternator is seldom used, and is idle during forward rotation of the propeller. Therefore it can be rated on a short-time basis and be considerably smaller than for the usual continuous-duty electric drive.

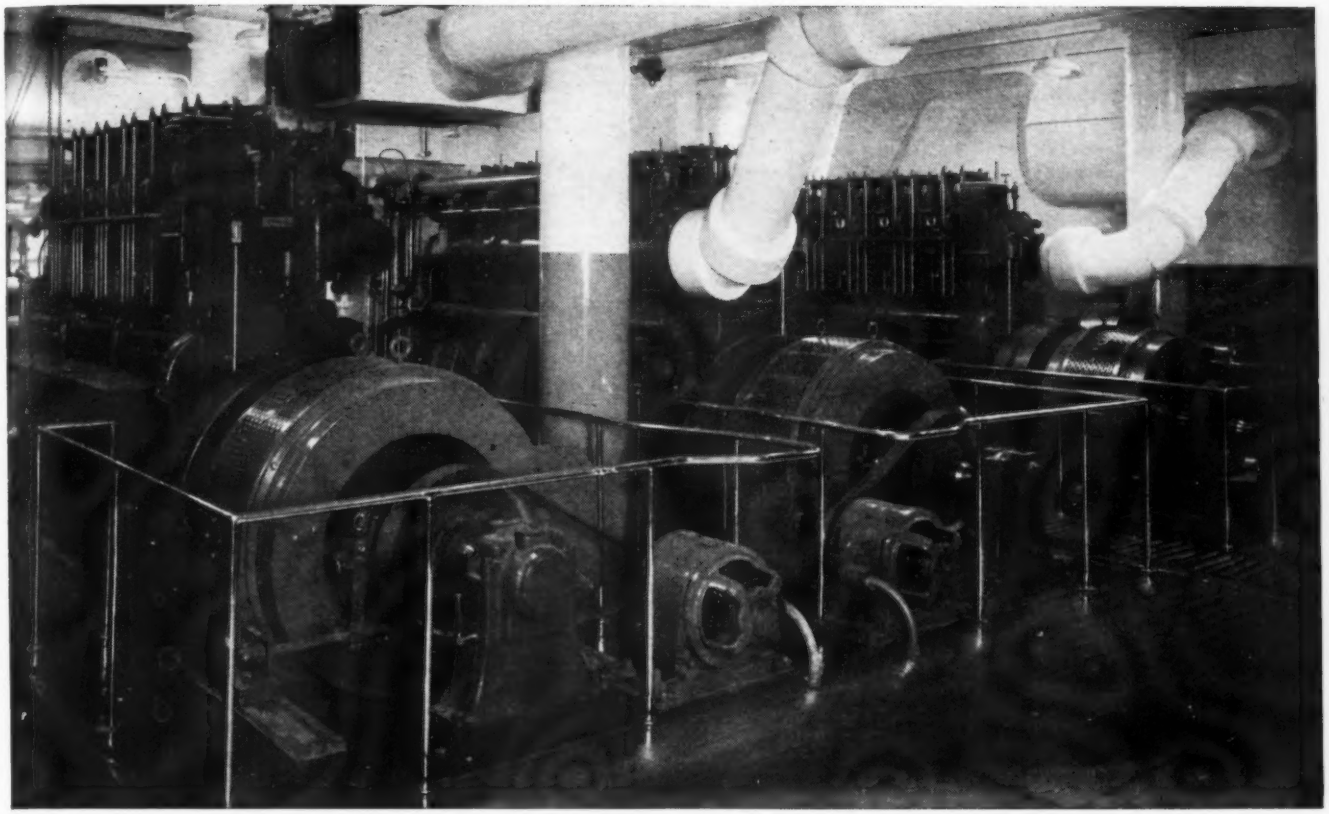
ACKNOWLEDGMENTS

In preparing material on magnetic clutches Power is indebted to Cutler-Hammer Inc, Dings Magnetic Separator Co, Stearns Magnetic Mfg Co, all of Milwaukee, Wis.; and to Twin-Disc Clutch Co, Racine, Wis.

Material from which the electric-coupling and magnetic-drive articles were written was supplied by Dynamatic Corp, Kenosha, Wis.; Electric Machinery Mfg Co, Minneapolis, Minn.; Elliott Co, Ridgway, Pa.; General Electric Co, Schenectady, N. Y.; and Westinghouse Electric Corp, East Pittsburgh, Pa.



16 Reversible constant-speed magnetic drive, with synchronous alternator on the left and an induction motor on the right with two windings on rotor



How to Install and Maintain Diesel Valves, Seats and Guides

Valve-mechanism operation makes or mars performance of diesel and gas engines. Here's a comprehensive and authoritative discussion of tested procedures for valve installation and maintenance, based on 23 years experience in shop and field

▶ OPERATORS OF INDUSTRIAL diesel and gas engines have no single source of reference for authoritative and comprehensive information on poppet-valve installation and maintenance. Common practice has been to follow rule of thumb methods handed down from journeyman to apprentice operator. It is hoped that the following summary of facts, gathered through 23 years of field and shop work for the world's largest engine-valve manufacturer and from extensive engineering-department research in the laboratory and on the engine test block, will go a long way toward filling this gap.

Engineers often speak of the valve mechanism of a 4-cycle internal-combustion engine as the heart of the unit. This is almost literally true, as valve leakage shortens life expectancy of the valve mechanism and to a certain extent, of the engine itself. Although fuel-injection-valve mechanism in a 2-cycle engine does not affect operation as do 4-cycle inlet and exhaust valves, it exerts an important influence on engine efficiency.

Assuming that best available materials form the valve-mechanism parts, let's look at the problems involved in obtaining maximum performance and life and thus arrive at a recommended procedure for installation and servicing of valves.

By J D CREEK

Mid-Continent Division Manager, Thompson Products, Inc

As we know, any valve acts as a mechanical seal for an opening which at times is under pressure. It goes without saying that the better the seal the more efficient the operation and the longer the life of both valve face and its mating seat surface. This is particularly true on engine poppet valves where compressed gas at high velocity and temperature upward of 3000 F may pass across a valve face not properly seated when combustion occurs. This stresses the necessity of obtaining as nearly as possible perfect alignment between valve, seat and guide so the valve and seat may perform their sealing function without undue interference. This means viewing the entire valve mechanism as made up of interrelated parts, with relative preference shown to parts exposed to highest temperatures. Heat is the worst enemy of an internal-combustion-engine valve.

If a new valve as it comes from the maker is straight and its face is concentric with the stem to within required

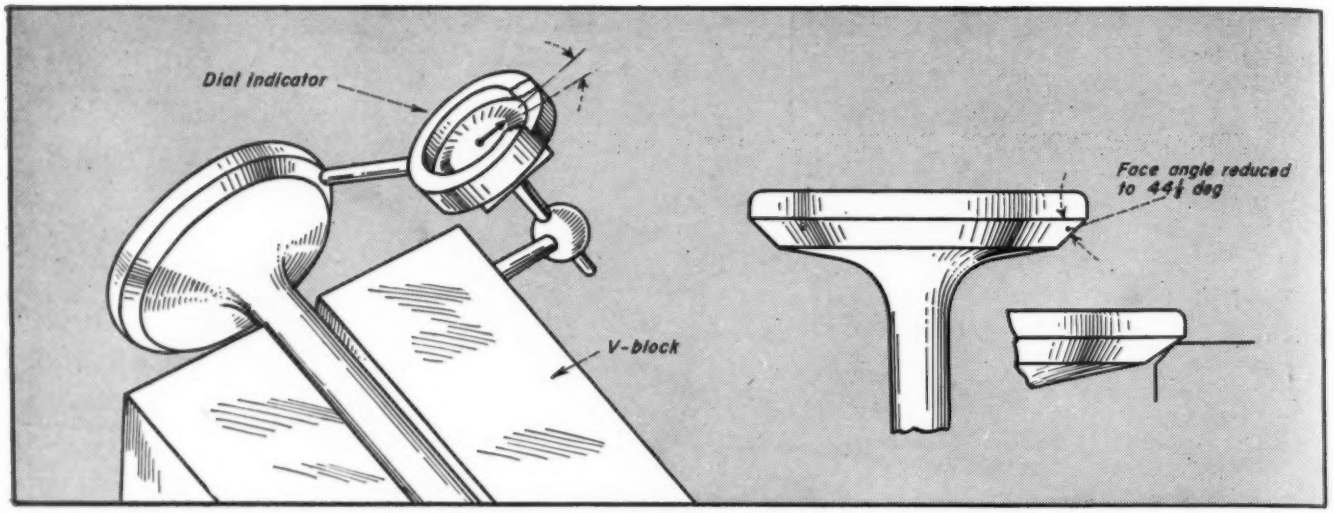


Fig. 1 (left)—Setup for checking concentricity of valve face to stem using a dial indicator. Fig. 2 (right)—Exaggerated view of the change in valve-face angle used when guttering has occurred on the face during valve's operation in engine

limits, little preparation is needed for installation. If micrometer calipers are available, measure the stem and inside bore of the guide to see if proper allowance has been made for running clearance. Clearance between stem and guide can also be checked by thickness gage.

Running clearance is extremely important: too little causes valve to stick in guide after operating temperature is reached and too much causes valve to "wallow out" the seat. Proper clearance varies with engine type, operating temperature, etc, but a safe rule for exhaust valves with alloy-steel stems is to allow one-thousandth of an inch clearance for every eighth inch of stem diameter. In other words, a valve with a 7/8 in. stem should carry a mean of 0.007 in. clearance. Valves with stems larger than 1/2 in. stem diameter generally operate with less clearance than this rule provides, because cooling is better and operating speed slower. Inlet valves should show clearances of about 0.001 in. for each 3/16 in. of stem diameter. Table 1 gives recommended stem clearances.

Valves which have seen operation and are removed from the engine for servicing should be checked for stem wear and stem straightness and should be refaced if necessary. Refacing may be done in an engine lathe with a toolpost grinder or, where available, in a valve-refacing grinder. Remove only enough metal to obtain a suitable seating surface as in operating the valve-face surface work-hardens to some extent and removing excess metal simply eliminates this desirable condition.

Some operators become unnecessarily alarmed over pitting on faces of stainless-steel valves. In diesels or gas engines burning considerable lubricating oil, this pitting may be expected and results from small carbon particles impinging on the valve face. Unless the pits form an interconnecting line across the face, the condition has no bearing on valve serviceability and should be ignored. In refacing these pits need not be removed.

Concentricity of valve face to stem should be held to a maximum of 0.003 in. total runout, Fig. 1. Regrind valve-face angle to match seat-face angle exactly, unless "guttering" has occurred. Guttering may be defined as the washing out of a trench across the valve face. Where this condition occurs it is desirable to face the valve at an angle 1/2 deg flatter than the seat-face angle. In other words, if seat-face angle is 45 deg, face valve to 44½ deg. This exerts greater pressure on the upper edge of the valve face and assures more certain sealing.

In accepted practice, the valve face overlaps the seat face on both upper and lower edges. This method provides a more positive seal and precludes possibility of undue seat and guide wear when misalignment occurs between these parts. It also lessens the chance of the valve head doing a "reverse umbrella".

Valve-face and seat-face widths vary because of peculiarities of design and operation of the valve mechanism. I favor a middle of the road policy on this subject. Inasmuch as about 90% of the heat absorbed by an exhaust-valve head transfers through the face during the short interval it rests on the seat, contact area must be sufficient to effect this transfer properly. On the other hand, too great a contact area produces low unit pressure against the seat and may result in flutter. Inlet and fuel valves should have relatively narrow faces, as no heat-transfer is involved and a narrow seat generally assures a more positive seal.

Recent practice involves use of removable exhaust-valve seats. This is accomplished in seat-in-head or seat-in-block engines by means of a ring insert usually installed with an interference fit between insert and counterbore. Threaded seats have been used but in most cases without great success. Unless threads are ground to a perfect mating fit, air gaps between seat and counterbore wall tend to retard necessary heat transfer.

Experience shows that it is almost impossible to install an insert with an inter-

TABLE I—AVERAGE CLEARANCE

Valve-stem diameter, in.	*Inlet-valve clearance, in.*	*Exhaust-valve clearance, in.*
1/2	0.0020–0.0040	0.003–0.005
5/8	0.0025–0.0045	0.004–0.006
3/4	0.0030–0.0050	0.005–0.007
7/8	0.0040–0.0060	0.006–0.008
1	0.0045–0.0065	0.007–0.009
1 1/8	0.0050–0.0070	0.008–0.010
1 1/4	0.0055–0.0075	0.009–0.011
1 3/8	0.0060–0.0080	0.010–0.012
1 1/2	0.0070–0.0090	0.011–0.013
1 5/8	0.0075–0.0095	0.012–0.014

ference fit and have it remain perfectly flat against the counterbore's bottom. Consequently, it is estimated that about 90% of the heat transfer from seat to cylinder head or block occurs through insert sidewall. This emphasizes the importance of obtaining best possible contact between outer wall of insert and radial wall of counterbore. Most valve-seat manufacturers furnish inserts with a smoothly ground outside surface. However, lack of proper equipment often prevents grinding the counterbore to an equally smooth finish. There is now available to industrial-engine operators a rotary valve-seat grinder that will grind counterbores of from 3¾ to 11 in. diameter, as well as grind seat angle on seats through this size range.

On gas and diesel engines having removable valve cages, general practice involves installing a valve seat with a shoulder, which replaces the nose end of the cage. Inasmuch as this seat is held in the cylinder head by the cage hold-down bolts, somewhat less painstaking care is required for installation. However, to obtain maximum operating efficiency and seat service a certain definite procedure should be followed in installation.

First, let's outline recommended procedure for installing interference-fit seat inserts. Allowance for fit between insert and counterbore, of great importance, is determined by outside diameter and radial (wall) thickness of the insert. Table 2 gives recommended allowances for alloy-steel inserts. A properly designed seat insert with radial thickness in proportion to outside diameter requires a mean of 0.003 in. press fit. Because most alloy-steel seats have a slightly higher expansion coefficient and greater elasticity than cast iron, it is not desirable to force them into counterbores with an interference fit larger than necessary.

Once counterbore size has been determined and properly bored or ground, prepare the insert for installation. It is recommended that where proper material is available, inserts be shrunk before placing them in the counterbore. Dry ice is preferable for this purpose, but butane or propane proves satisfactory. Parts may be sandwiched between thin slabs of dry ice and covered with paper and cloth or may be immersed in a container of denatured alcohol or kerosene and dry ice . Keep parts in contact with refrigerant until thoroughly cooled; this requires about 30 min average.

If propane or butane is used, place seats in a shallow container and spray liquid gas against them until they become coated with frost instantly when exposed to the atmosphere. Some operators prefer to heat cylinder heads as well as freeze seats. If this is done, heat the head in boiling water. Never use a blow-torch or acetylene torch as this may cause distortion and resultant cracking. Clean the counterbore and take seats from refrigerant as needed.

The operator may make a satisfactory permanent tool for installing one size of seat from a round bar of steel at least ½ in. larger in diameter than the valve-guide bore and long enough to extend well into the guide on one end and about 6 in. above cylinder head or block on the other. Machine entire length of bar, except for about 6 in., to a slip fit in the valve-guide bore, leaving a square shoulder on the 6-in.-long unmachined section. This 6-in. length serves as a handle and driver.

Now machine a steel disk slightly smaller in diameter than the OD of the seat insert and about ½ to 1 in. thick, depending on size of seat to be installed. Bore a hole in the disk center about 1/64 in. larger than pilot part of bar and machine a shoulder on it about 1/64 in. smaller in diameter than the seat insert's inside bore. When insert is shrunk and ready for installation, insert driver pilot through disk, which is then placed on top of the insert, and through the valve-guide bore. Hammer on top to drive insert into counterbore, Fig. 3.

For a temporary tool, weld a 6-in. length of round bar stock, for a handle and driver, to the center of a circular steel plate slightly smaller in diameter than the seat's outside diameter. Preferably, a shoulder should be machined on the side of the plate opposite the handle to fit easily into the seat insert's inside bore. Driving the seat with this tool insures that it goes in straight and eliminates possibility of fracturing it, as sometimes happens when hammer blows are directed against the seat itself.

After driving the insert into the bottom of the counterbore, allow it to return to normal temperature. Then peen lightly the cylinder-head metal against the chamfer on the insert's upper outside edge. This eliminates possibility of the insert being wedged under the valve

TABLE II—INTERFERENCE FIT
In Thousandths of an Inch

Wall thickness, inches	Outside diameter, inches																			
	0	1	2	3	4	5	6	7	8	9	10									
1/16	006	006																		
1/8	003	003	005	006																
3/16	002	002	003	004	005	006														
1/4	0015	002	002	003	004	005	005	006												
5/16	0012		002	002	003	004	004	005	005	006										
3/8	001		002	002	003	003	004	004	005	005	006	006								
7/16	00086			002	002	003	003	003	004	004	005	005	006	006						
1/2	00075			002	002	002	003	003	003	004	004	005	005	005	006	006				
9/16	00067				002	002	002	003	003	003	004	004	004	005	005	005	006	006		
5/8	0006				002	002	002	002	003	003	003	004	004	004	005	005	005	005	006	006
11/16	00055					002	002	002	002	003	003	003	004	004	004	004	005	005	005	006
3/4	0005					002	002	002	002	003	003	003	003	004	004	004	004	005	005	005
13/16	00046						002	002	002	002	003	003	003	003	003	004	004	004	004	005
7/8	00043						002	002	002	002	002	003	003	003	003	003	004	004	004	004
15/16	0004							002	002	002	002	002	003	003	003	003	003	004	004	004
1	00038							002	002	002	002	002	002	003	003	003	003	003	004	004
1 1/16	00035								002	002	002	002	002	002	003	003	003	003	003	004
1 1/8	00033								001	002	002	002	002	002	002	003	003	003	003	003
1 3/16	00032									002	002	002	002	002	002	002	003	003	003	003
1 1/4	0003									002	002	002	002	002	002	002	002	003	003	003
1 5/16	00029										002	002	002	002	002	002	002	003	003	003
1 3/8	00027										001	002	002	002	002	002	002	002	003	003
1 7/16	00026											002	002	002	002	002	002	002	002	003
1 1/2	00025											002	002	002	002	002	002	002	002	003
1 5/16	00024												002	002	002	002	002	002	002	002
1 5/8	00023												001	002	002	002	002	002	002	002
1 11/16	00022													002	002	002	002	002	002	002
1 3/4	00022													002	002	002	002	002	002	002

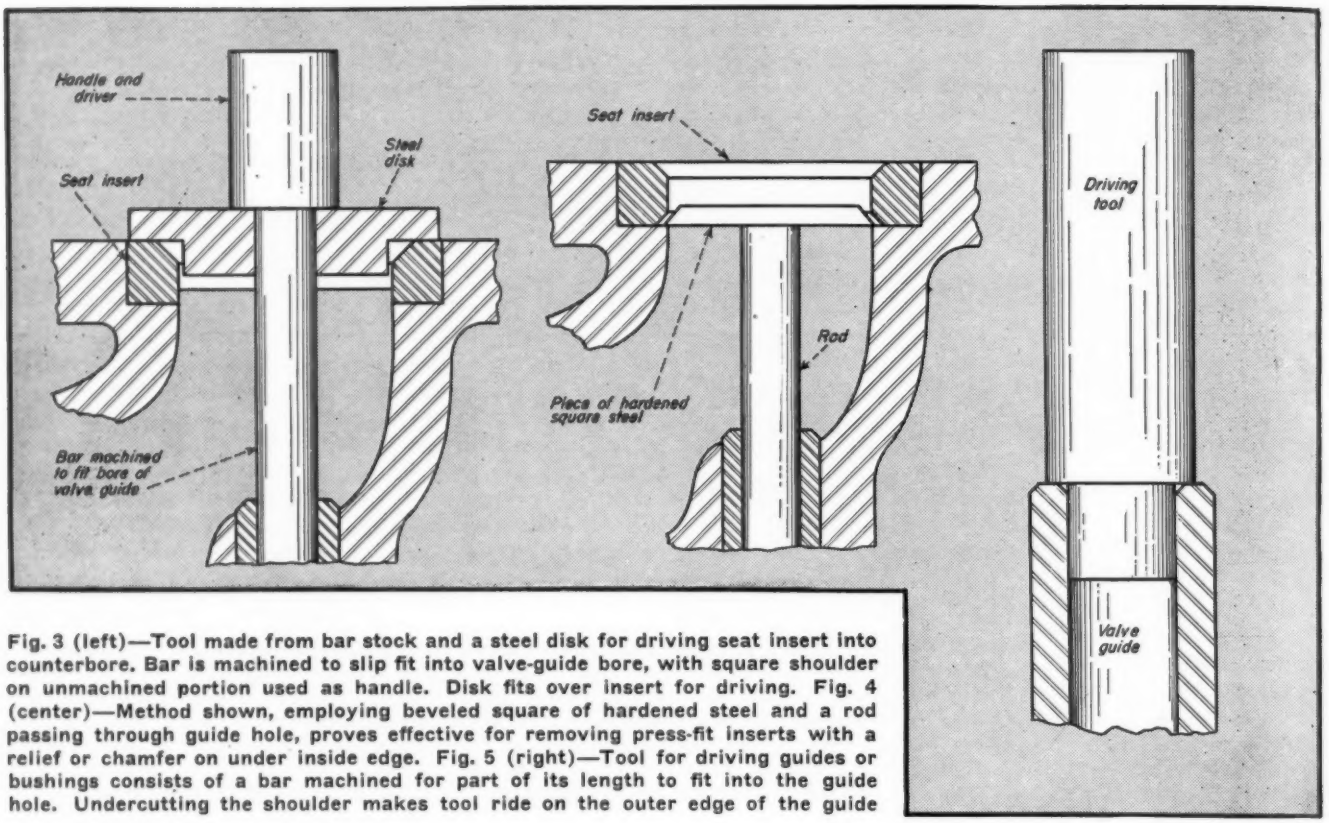


Fig. 3 (left)—Tool made from bar stock and a steel disk for driving seat insert into counterbore. Bar is machined to slip fit into valve-guide bore, with square shoulder on unmachined portion used as handle. Disk fits over insert for driving. Fig. 4 (center)—Method shown, employing beveled square of hardened steel and a rod passing through guide hole, proves effective for removing press-fit inserts with a relief or chamfer on under inside edge. Fig. 5 (right)—Tool for driving guides or bushings consists of a bar machined for part of its length to fit into the guide hole. Undercutting the shoulder makes tool ride on the outer edge of the guide

head if a cracked cylinder head, distortion or other cause loosens the insert in the counterbore.

The insert is now ready for seat-angle grinding, a most important step. Seats with face diameters up to 3¾ in. may be ground with a concentric-type automotive seat grinder, several makes of which are available. Seats above this size should be ground with a rotary grinder of the type previously mentioned. Both types of grinders revolve around a pilot in the valve guide. In the automotive type, a ball-bearing unit which revolves around the upper part of the pilot carries the grinding wheel. The full periphery of the stone, dressed to the desired angle, is in contact with the seat. In the rotary grinder, the spindle carrying the grinding wheel is offset from the pilot bearing and the entire unit rotates around the pilot, with only a small portion of the stone's peripheral surface in contact with the seat at any time. Both designs are capable of grinding seat-face angles to within 0.001 in. of concentricity between seat and guide. Dial indicators are furnished for checking this concentricity.

After grinding the valve seat angle true to the guide within required limits, check it against the valve to make sure the angle is correct and matches the valve face in the proper proportions. This may be done by smoothing a thin coating of prussian blue on the valve face and rotating it on the seat without pressure, or by lapping it in lightly with a fine water-soluble grinding compound.

In regrinding seats which have been in operation for some time, it may prove necessary to remove considerable stock to bring the seat into concentricity with the guide and in so doing the seat face will become wider than the valve face. When this happens it is advisable to narrow the seat face by using a grinding wheel with an angle about 15 deg flatter than the seat angle. In other words, if the seat angle is 45 deg, use a grinding wheel dressed to 30 deg. The upper seat-face diameter should always be at least 1/16 in. less than upper valve-face diameter.

Our experience indicates that the less an alloy-steel valve is ground with compound the better it will function. High-heat-resisting steels have a much higher coefficient of expansion than low-alloy steels or cast iron and thus will not seat in the same position when hot as when cold. If a ridge is ground into the valve or seat with compound, the valve will in all probability ride on that ridge when it attains normal operating temperature. Exercise great care when lapping-in steel valves on steel seats with grinding compound, because rubbing steel against steel without lubrication tends to cause galling and cut small grooves in the faces.

Before introduction of the large valve-seat grinder, it frequently proved necessary to do considerable hand grinding with compound to bring seat in line with guide. Many service men picked up the habit of driving the valve with a power tool and applying extreme pressure to make the abrasive cut faster. If any other means of grinding is available this practice should be discouraged as it brings about the undesirable conditions previously mentioned. If the valve must be lapped-in with compound, rotate it against the seat with a tap wrench or lathe dog fastened on the end opposite the valve head. This insures lapping the valve into place in exactly the same position it will assume when the spring is installed. Exert no more pressure against the valve head when lapping than the weight of the valve itself. Change abrasive compound frequently and remove old compound from valve and seat before applying new.

Procedure outlined for installing press-in seat inserts may also be used to good advantage on cage seats although it is not essential that seats be shrunk before installation of the cage. This results from the fact that they are not held in place by interference fit and no peening is necessary where the seat extends into the cylinder head. With removable

(*Continued on page* 154)

SHORT CUTS TO PLANT EFFICIENCY

By W A SHOUDY

No. 2—Let's Look at the Heat Balance

In this practical series based on fundamentals, experience and common sense, a consulting engineer shows how to design an economical plant for process steam and power. Here actual test reports of three boilers reveal the effect of unit design on the heat-balance losses.

▶THERE IS NOTHING MORE MYSTERIOUS in a boiler-heat balance than in the trial balance that a bookkeeper strikes off each month although it is sometimes more difficult to compute. The bookkeeper's trial balance tells whether his books are in order; the heat balance tells an engineer whether his test data are accurate—but it tells him more. The heat balance shows the engineer *why* the boiler efficiency is low and points out the way to improve it.

Our largest source of published boiler tests is the public utilities. In fact, the central stations have been excellent research laboratories in steam power and an industrial power engineer can make good use of their published data.

From the hundreds of tests published in the transactions of the ASME we have selected three because each shows a step in the improvement of steam-generating efficiency.

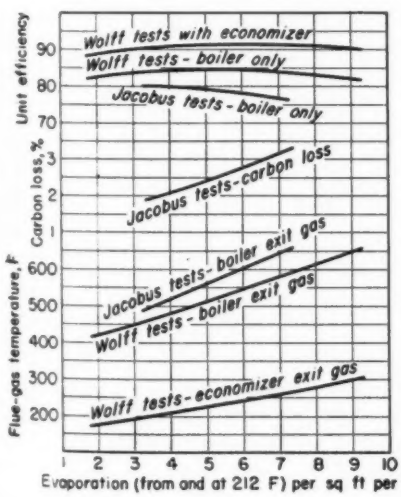


Fig. 1—How the temperatures and efficiency varied with the evaporation rate

The first is from a series of tests made in 1911 by Dr D S Jacobus and presents the highest boiler and furnace efficiency published up to that time. The second from a series conducted by John Wolff gives the results obtained with an almost identical boiler but with an economizer added. The third by A E Grunert is from a series of tests of a steam-generating unit consisting of a small boiler with a large economizer and a large air heater. This unit had a completely water-cooled furnace. Total evaporating surface, boiler and waterwalls, was about one quarter of that of the Wolff unit. Yet it generated 25% more steam at about the same efficiency.

By examining the heat balances of these tests, we learn why the efficiency of the Wolff boiler was higher than that of the Jacobus boiler and how Grunert was able with a smaller boiler to generate more steam than either, yet with substantially no loss in efficiency. If he had had the same coal as Wolff their efficiencies would have been the same.

Let us first consider each item of the heat balance. Then we can analyze these three tests and understand the reasons for their differences.

Radiation and unaccounted-for losses. This is the first item to examine although it appears at the bottom of the table, "Comparison of Three Boilers." It is determined by adding to the heat that is added to the water and steam all the losses that can be computed and subtracting this sum from the heat of the fuel. It is an indication of the test's accuracy. *Radiation* is sometimes computed and reported separately but at best it is only an estimate. The item is small and does not differ materially in boilers of about the same size if the settings are in good condition.

The *unaccounted-for* losses include inaccuracies in measurement and losses that are difficult to measure accurately—principally cinder escaping through the chimney, carbon carried out with the ash and unburned hydrocarbons.

W A SHOUDY

The Jacobus test shows the highest radiation and unaccounted-for (r and u) losses of the three tests. This does not mean that his test was inaccurate for no one conducts a test more accurately than he. The other tests of his series show substantially the same r and u losses, so this test is representative. We must look further for an explanation.

This test is one of a series conducted on one of the largest underfeed stokers of its day. The unburned carbon left in the ash was nearly 30%. It was difficult to get a true sample of the ash because of the large quantity. Any error in determining the percent of unburned carbon even though avoidable made a large error in the heat balance. Methods of sampling the cinder entering the chimney had not been fully developed. In addition the cinder loss could not be measured. This high r and u loss was undoubtedly due to unburned carbon that could not be measured. The present-day stoker operates with a much lower carbon loss, and there

are now better methods of sampling the cinder discharge. The r and u loss of the modern stoker test is about the same as that for pulverized coal.

The tests of Wolff and Grunert show a low r and u loss because pulverized coal was burned and the small percentage of unburned carbon could be measured more accurately. This low loss makes us willing to accept the tests, and we may proceed with the analysis.

Heat absorbed by the steam-generating unit. When this item is expressed in percent it is the gross efficiency of the unit, or *unit efficiency.* When the unit consists of a furnace and boiler we speak of the efficiency of the boiler and furnace. When a superheater is added the term becomes boiler, superheater and furnace, and if an economizer or air heater is added to the boiler these names must be added to the definition. It is simpler to use the term *gross unit efficiency.*

Net unit efficiency is determined by subtracting from the gross unit efficiency the heat equivalent of the power required to drive the fans and stoker, or pulverizer, expressed in percent of total heat input. It is a difficult calculation that is seldom used. *Unit efficiency* is generally understood to mean gross unit efficiency.

It is impractical to measure, in percentage, the efficiency of the furnace, or combustion efficiency. A combustion efficiency of 100% means zero excess air, zero CO, all carbon burned to CO_2 and no heat loss by radiation to the boiler room. Boiler efficiency, strictly speaking, is the percent of the heat received from the furnace that is absorbed by the boiler, but it is difficult to separate the two efficiencies. *Boiler efficiency* is now understood to mean *combined boiler and furnace efficiency. Unit efficiency* is a better term. Boiler efficiency is indicated indirectly by the temperature of the flue gas leaving the boiler. If we add an economizer or air heater we decrease the flue-gas temperature and increase the unit efficiency but boiler efficiency is the same.

Losses due to (1) moisture in air entering furnace or air heater (2) moisture in fuel (3) burning hydrogen of the fuel to H_2O. We can do little to reduce these losses. We might run our tests on a dry day. We can leave the coal in the sun to dry but the hydrogen is a part of the fuel. Because of the high hydrogen and moisture content of some Midwestern coals we cannot expect as high efficiency as is obtained with most Eastern coals. The high hydrogen content of oil makes it impossible to obtain as high a unit efficiency when firing oil as when using pulverized Eastern coal.

We must accept these losses but include them in the heat balance to explain a possible low unit efficiency.

Loss due to incomplete combustion of carbon. This is shown by the presence of CO in the furnace gas. This may be due to lack of sufficient air for combustion but a measurable percentage of CO generally means that the space for flame travel is not sufficient, the fire bed is in poor condition, or the burners are out of adjustment. The CO must be watched carefully and measured accurately. Two tenths of 1% of CO indicates a loss of about 1% in efficiency—the equivalent of about 40-F rise in flue-gas temperature when the CO_2 is high.

To avoid forming CO we must pay particular attention to the furnace design for any new installation, making sure that air distribution of the new stoker or burner is satisfactory and that there is ample space for flame travel. Otherwise CO will be found even with the most care-

COMPARISON OF THREE BOILERS

Company	*Detroit Edison Co*	*Cleveland Elec Illuminating Co*	*Commonwealth Edison Co*
Tests conducted by	*D S Jacobus*	*John Wolff*	*A E Grunert*
Volume of ASME transactions	*1911*	*1925*	*1931*
Firing	*Underfeed stokers*	*Pulverized coal*	*Pulverized coal*
Boiler heating surface, sq ft	23,654	30,600	5,940
Waterwalls and floor, sq ft	.....	835	2,468
Economizer, sq ft	.....	22,080	8,850
Air heater, sq ft	.....	.....	41,700
Total except superheater, sq ft	23,654	53,515	58,958
Maximum evaporation (f and a 212 F) obtained during series of tests, lb per hr	172,456	295,000	372,000
Maximum equivalent evaporation per sq ft of boiler and waterwall surface, lb per hr	7.27	9.31	43.10
TEST DATA			
Steam pressure, psi	192	240	325
Steam temperature, F	513	686	707
Equivalent evaporation (f and a 212 F) lb per hr	88,061	227,000	211,000
Equivalent evaporation (f and a 212 F) per sq ft boiler and waterwall surface, lb per hr	3.72	7.39	23.90
Btu per lb of dry coal	13,965	12,473	12,169
Ash in dry coal, %	5.91	12.6	13.69
Carbon in ash and refuse, %	27.07	0.0	2.50
CO_2 in gas leaving unit, %	13.69	14.50	14.68
CO in gas leaving unit, %	0.10	0.0	0.0
Gas temperature leaving boiler, F	493	596	1,138
Gas temperature leaving economizer, F	.....	259	453
Gas temperature leaving air heater, F	.....	.....	257
CONDENSED HEAT BALANCE			
Heat absorbed by steam-generating unit (gross unit efficiency) %	80.28	91.10	89.20
Loss due to moisture in coal, air and burning hydrogen to H_2O, %	4.69	4.00	3.98
Loss in dry chimney gas, %	10.12	4.20	4.18
Loss due to CO, %	0.40	0.0	0.0
Loss due to unconsumed carbon in ash and refuse, %	1.80	0.0	0.42
Loss due to preheated air for dryer, %	.....	.....	1.47
Radiation and unaccounted for losses, %	2.71	0.70	0.75
Total	100.00	100.00	100.00

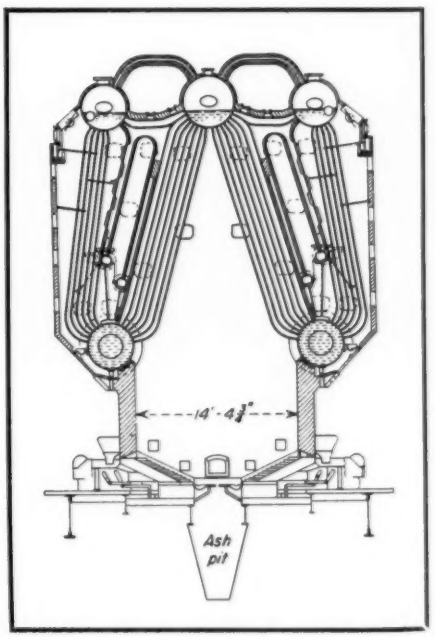


Fig. 2—Stoker-fired unit of Detroit Edison Co, tested by Jacobus in 1911, had 23,654 sq ft of boiler-heating surface, but no economizer or air heater

ful operation. The mistakes that we may make in selecting a boiler cause far less trouble than those made in designing a furnace; yet the furnace is generally given secondary attention. Design the *furnace first*, the boiler afterward.

Loss due to unburned carbon in the ash. This is also a furnace loss. It is due to the unburned carbon remaining in the ash and cinder carried into the chimney. The cause may be unskillful operation, bad stoker or burner design, or the nature of the coal.

A high-ash coal is more difficult to burn completely because the large volume of ash hinders the access of air to the remaining carbon. A friable coal breaks up quickly allowing the carbon to burn but it may throw a great deal of cinder. It is generally simpler to burn the carbon efficiently when the coal has been pulverized but improvements in stoker design now give practically equivalent results.

In the Jacobus tests carbon in the refuse was 27%, and loss in heat balance, 1.8%. In the Wolff and Grunert tests carbon loss was negligible.

Keep an eye on the ashes removed from the plant. Black ash means that the efficiency is not tops. One of the reasons why efficiency is often higher with pulverized coal than with stokers is that the carbon loss is lower. High efficiency is easier to maintain with oil than with coal because there is no ash to carry out the air with the fuel for complete combustion carbon and because it is easier to mix —also because carbon loss shows up as smoke.

Loss due to heat carried away with the dry exit gas. This loss is usually the highest of all, but fortunately it is under the control of both designer and operator. It often explains why operating efficiency is lower than guaranteed efficiency. This dry-gas loss equals the weight of gas per pound of fuel (figured from the flue-gas analysis) multiplied by the heat lost per pound of gas. This latter is the difference in the heat content of the gas as it enters the breeching and what it would have been had it cooled to 70 F.

Accuracy of the test therefore depends on accuracy of flue-gas analysis and measurement of the exit-gas temperature. Because boiler furnaces and breechings are wide true average values require skillful handling. Readings at one point of the furnace or flue are useful only as a guide to show changes in conditions. They are often misleading if used to show efficiency.

From the fuel's chemical analysis we may compute the weight of theoretical air required for combustion—what we might get in a laboratory. From this and the flue-gas analysis we may determine the actual weight of air supplied and the

(*Continued on page* 210)

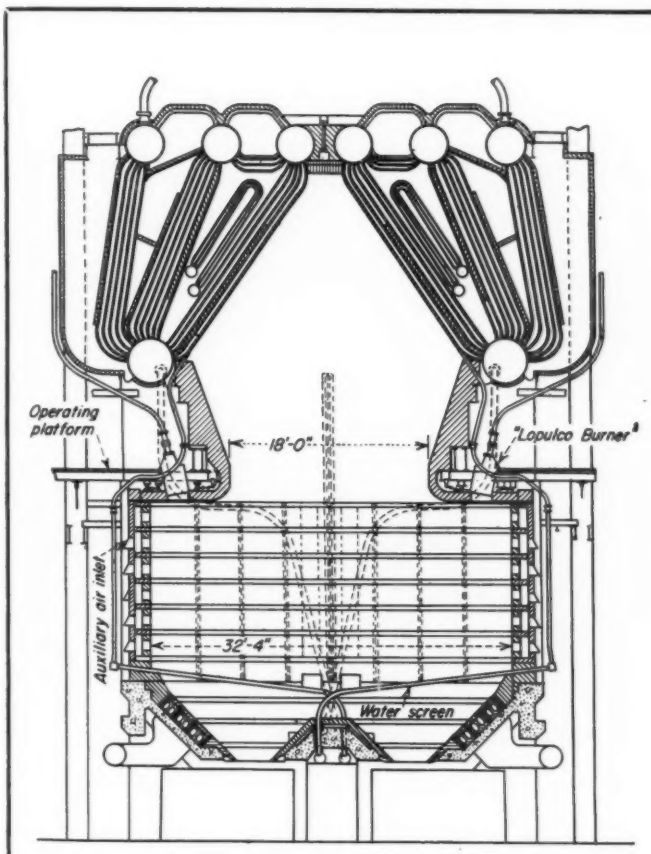


Fig. 3 (above)—Pulverized-coal-fired unit in Cleveland that was tested by Wolff in 1925 had 30,600 sq ft of boiler-heating surface, 835 sq ft of waterwalls and floor, 22,080 sq ft of integral economizer. It had no air heater.

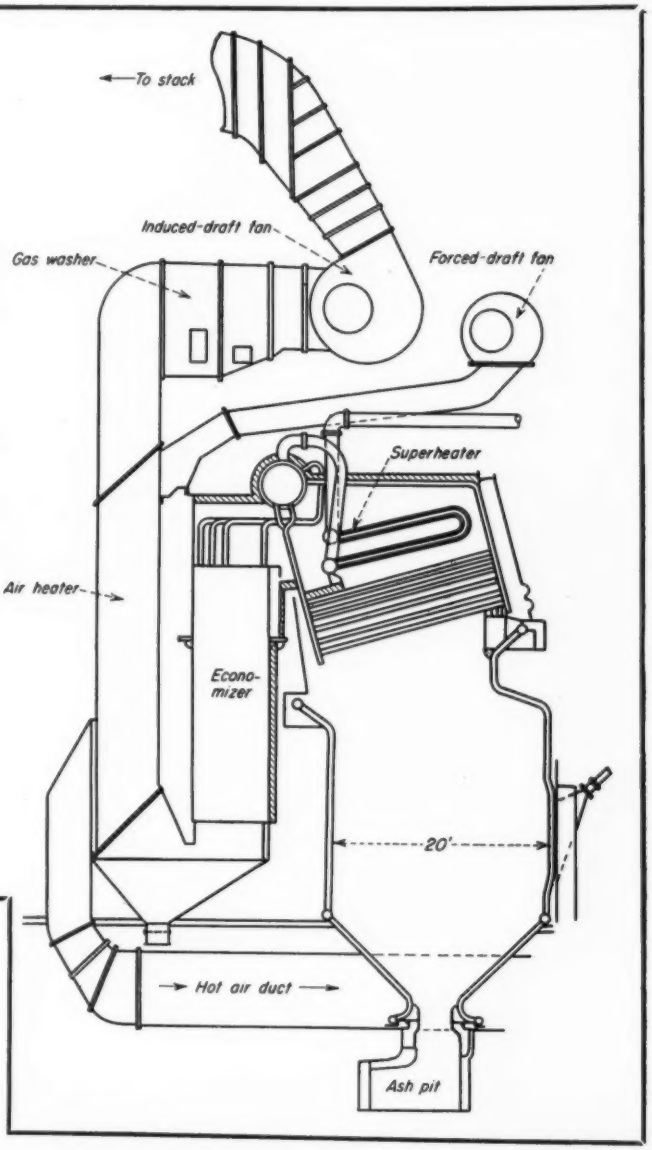


Fig. 4 (right)—Pulverized-coal-fired unit in Calumet tested by Grunert in 1931 has only 5940 sq ft of boiler-heating surface and 2468 sq ft in walls and floor. The economizer had 8850 sq ft and the air heater 41,700 sq ft of heating surface

Large Lumber Mill Modernizes Its Electrical Power System

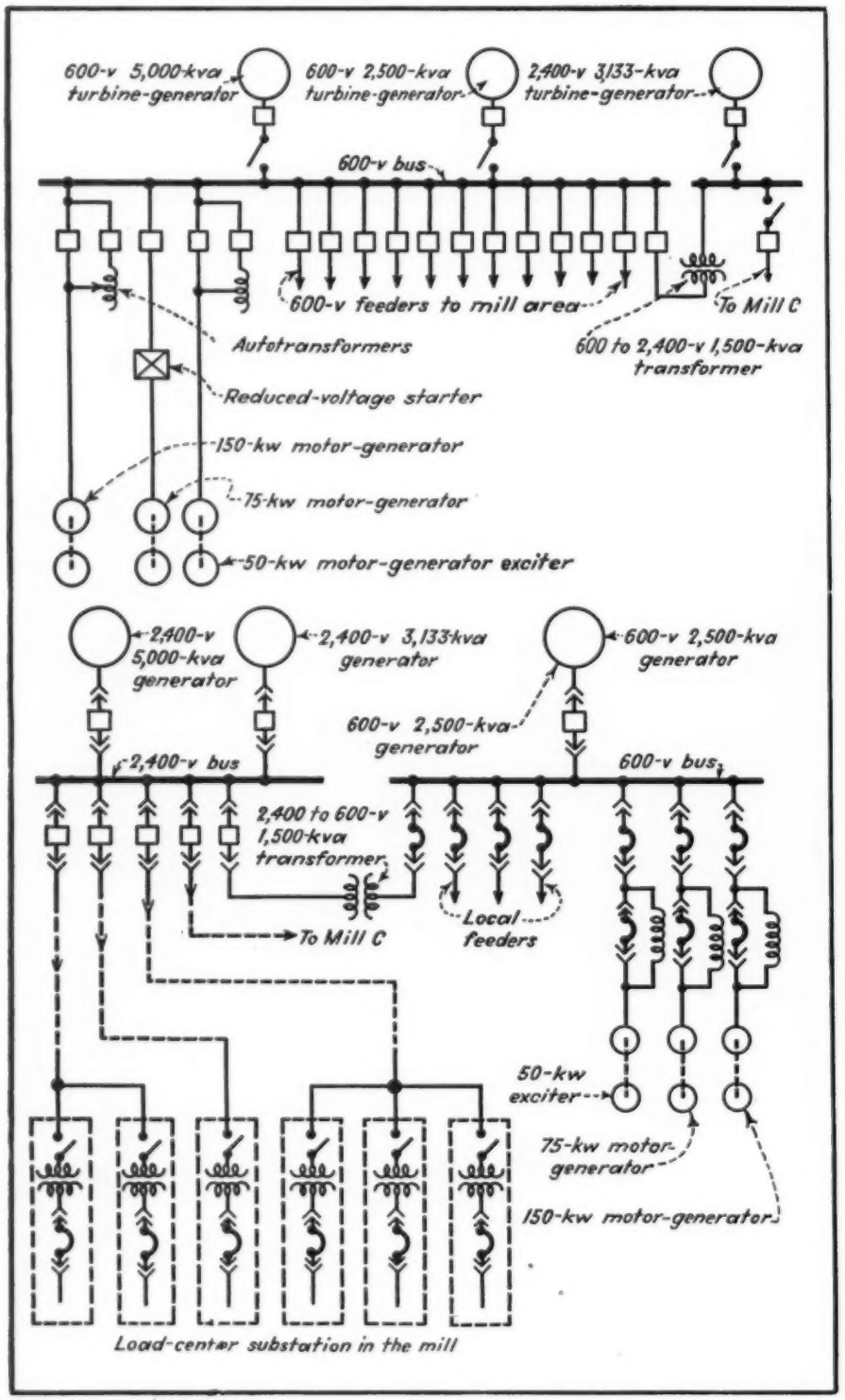


Fig. 1 (above)—One-line diagram of original 600-v power-system layout. Feeders were overloaded, voltage regulation poor, power losses high. Fig. 2 (below)—One-line diagram of new 2400-v power-generating, distribution and load-center unit-substation systems that supply 600-v circuits, motors, controllers, other equipment

K L Watts, chief electrician, tells how Mill B of the Weyerhaeuser Timber Co changed over in a 2-weeks' vacation from an overloaded 600-v power system with obsolete circuit breakers, poor voltage regulation and high power losses to 2400-v distribution and load-center substations

▶ At Everett, Wash., the Weyerhaeuser Timber Co started in 1915 a large lumber mill known as Mill B. Its enlarged daily capacity is now 750,000 board feet of fir lumber. Saws and other machinery are powered by electric motors supplied from a nearby power plant, which has a 5000- and a 2500-kva 600-v generator, and one rated 3133 kva, 2400 v—all steam-turbine driven.

The mill's electrical power distribution system was obsolete. The switchgear room, Fig. 4 and 5, was congested and unsafe because of open switchgear and the crowding of equipment for additions as the mill expanded. Added generator capacity increased the 600-v system's short-circuit current to over 100,000 amp whereas the oil circuit breaker's interrupting capacity was only 20,000 amp.

We were seriously concerned because a circuit breaker might have exploded when attempting to open a heavy short circuit. Destructive fire from such an explosion might badly damage the switchboard and its associated equipment besides crippling the mill's power supply. When we were making engineering studies for modernizing the electrical power system one of the oil circuit breakers did fail and cause a 24-hr shutdown. Because of the long 600-v feeders, copper losses were high and voltage drop excessive in the old system. We wished to correct all these conditions.

In the old electrical-power generating and distribution system, Fig. 1, the 5000-

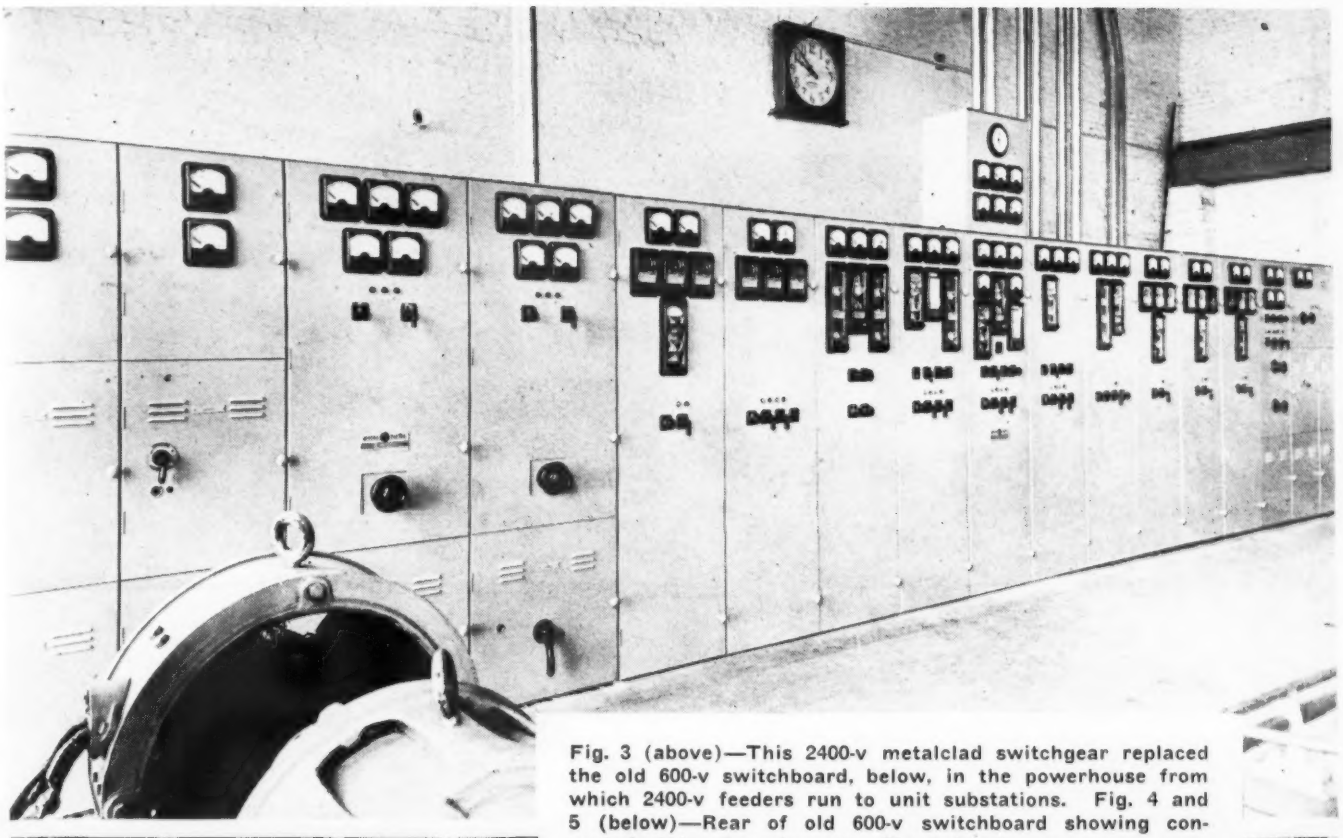
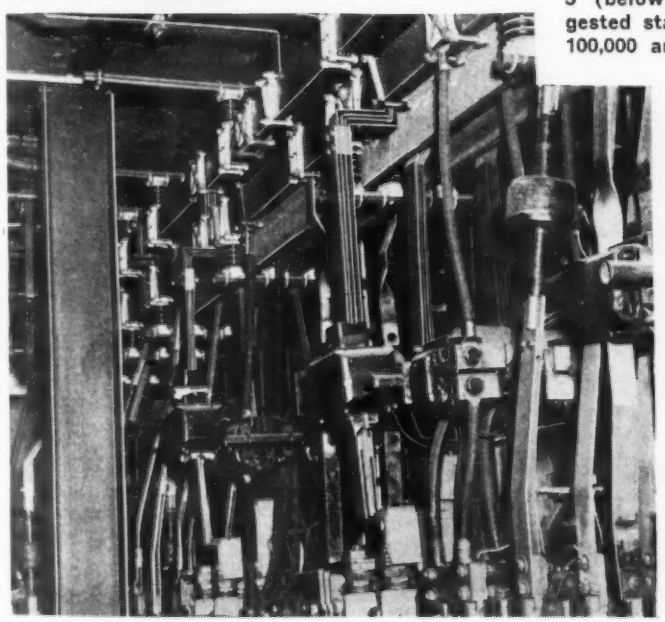
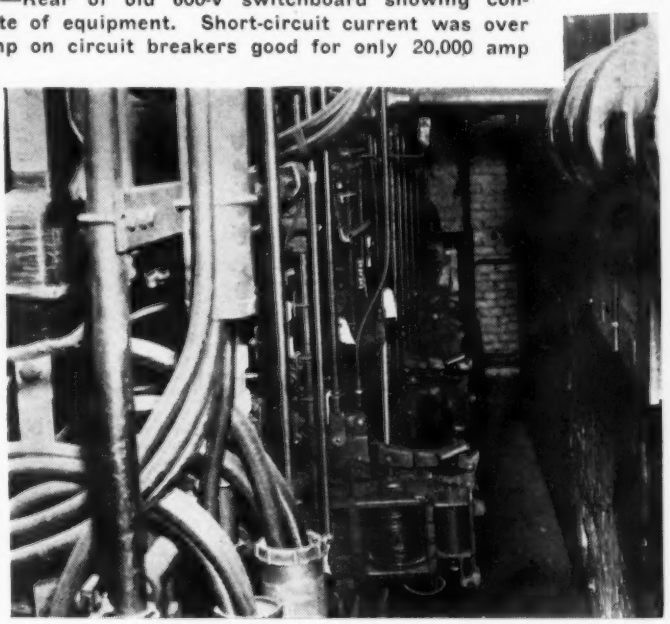


Fig. 3 (above)—This 2400-v metalclad switchgear replaced the old 600-v switchboard, below, in the powerhouse from which 2400-v feeders run to unit substations. Fig. 4 and 5 (below)—Rear of old 600-v switchboard showing congested state of equipment. Short-circuit current was over 100,000 amp on circuit breakers good for only 20,000 amp





and 2500-kva 600-v generators connect directly to the main bus. The 2400-v 3133-kva unit, installed primarily to supply power to Mill C about one-quarter mile from the powerhouse, connects to the 600-v bus by a 1500-kva transformer.

We considered two plans for modernizing the distribution system and switchgear. (1) Replace the open switches and oil circuit breakers with a new 600-v air-break circuit-breaker switchboard, which could have been installed for about $85,000. This would have provided adequate short-circuit protection but would not have eliminated excessive losses and high voltage drop in the long 600-v feeders. Mill expansion with the 600-v system would also have been expensive. (2) Increase the plant's voltage to 2400 v using a load-center distribution system. We selected this system as the most economical and best suited to present and future needs. Fig. 2 diagrams the new load-center system. When making the change it was advantageous to use the 2500-kva generator on the 600-v bus to serve load near the powerhouse and the three motor-generators. We purchased new 600-v switchgear for this service.

We connected the existing 3133-kva generator to a new 2400-v bus and rewound the 5000-kva generator for that voltage, Fig. 8. Because of extra space in the stator slots we could add sufficient copper to the winding to increase the

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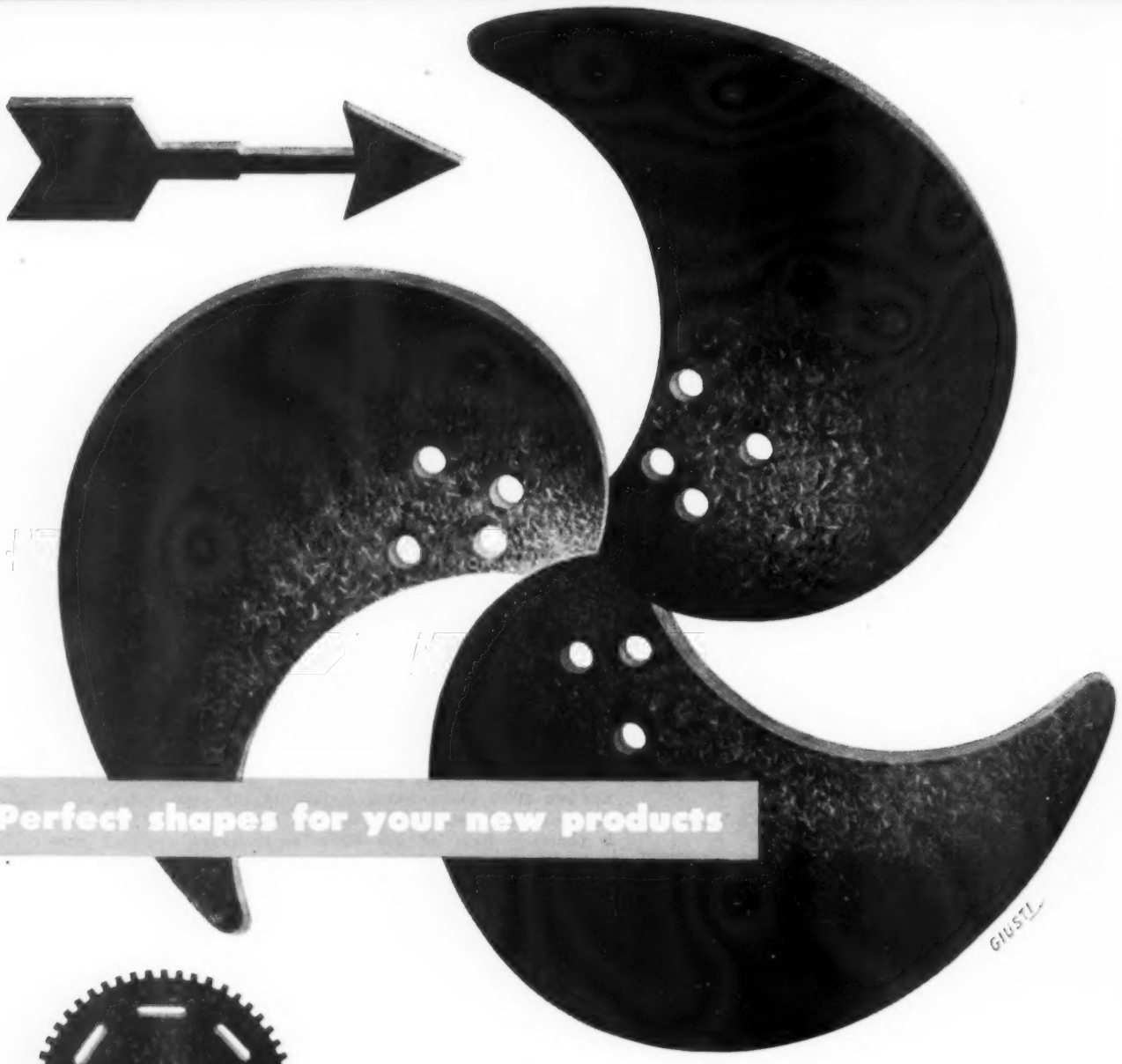

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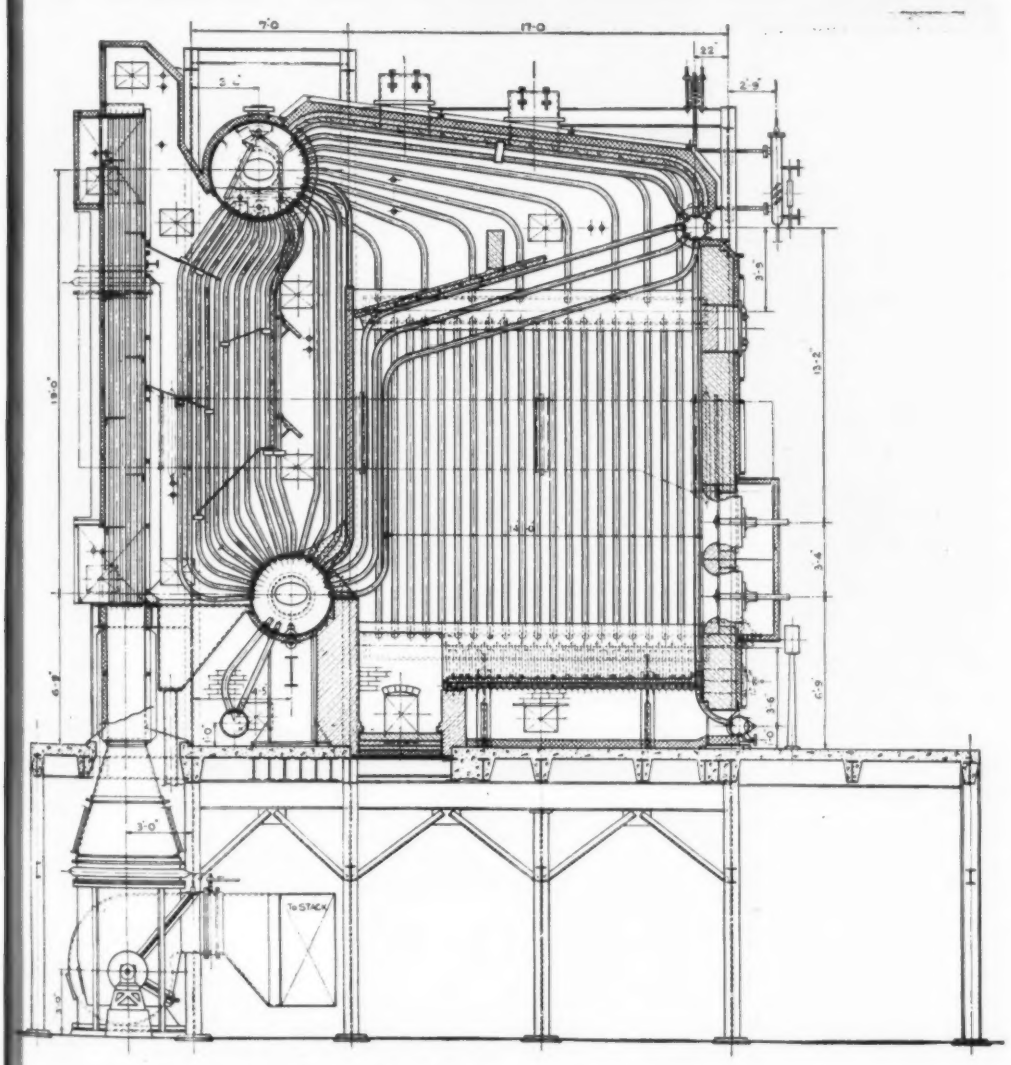

MASONITE CORPORATION, Laurel, Miss.
90,000 lbs. per hour Riley Steam Generating Unit
E. C. Grady, Plan Engineer

Riley's History at Masonite Corporation

June 28, 1939
One 50,000 lbs./hr. unit

September 16, 1940
Two 75,000 lbs./hr. units

February 8, 1943
One 90,000 lbs./hr. unit

September 22, 1944
One 75,000 lbs./hr. unit

November 6, 1945
One 90,000 lbs./hr. unit

All of these well-known companies have ordered Riley Units within the last year.

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Dow Chemical Co.
Boeing Aircraft Corp.
National Lead Co.
Standard Oil Co. of N. J.
Lee Tire & Rubber Co.
Pullman Std. Car Mfg. Co.
Celanese Corp. of America
Owens Corning Fiberglas Co.
Champion Paper & Fibre Co.
Chrysler Airtemp.
Beechnut Packing Co.
New Departure
American Cyanamid Co.
Lederle Laboratories
Modine Mfg. Co.
Allis Chalmers Mfg. Co.
Industrial Rayon Corp.
General Foods Corp.
Central Ill. Light Co.
Houston Lighting & Power Co.
South Carolina Power Co.
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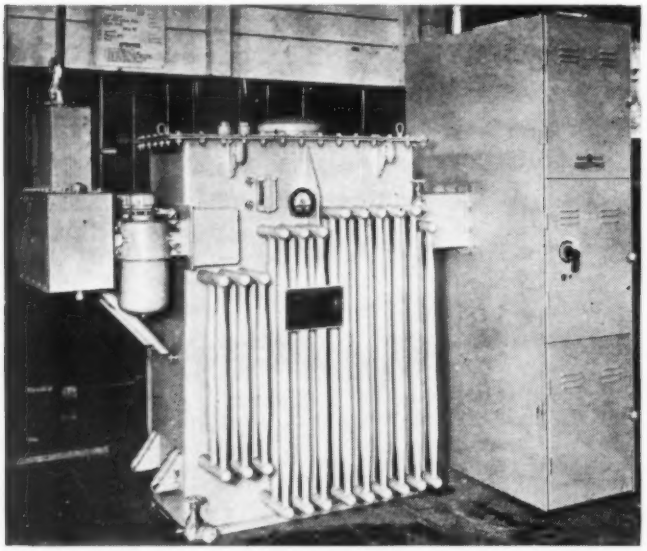


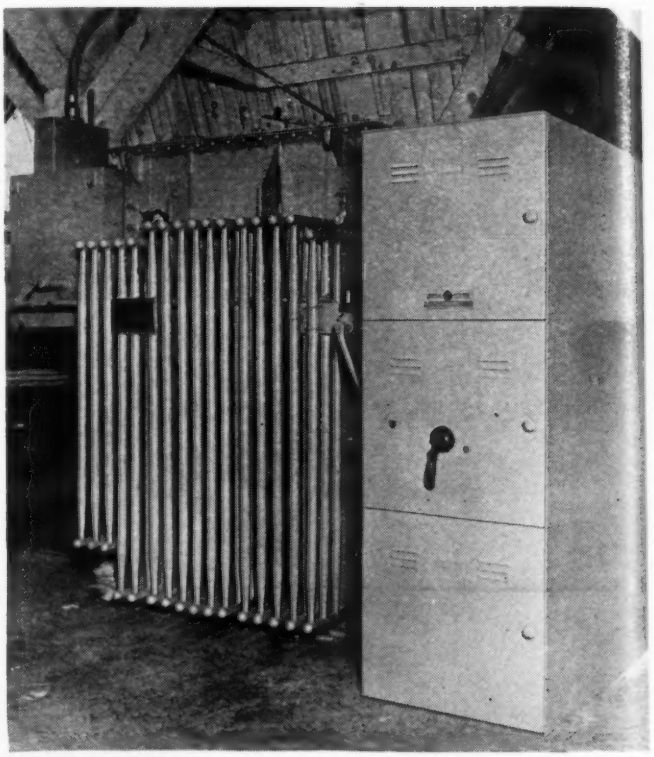


Fig. 6 and 7—The 300- and 1500-kva, 2400- to 600-v unit substations connect to new 600-v feeder air-break circuit breakers located in metalclad switchboard from which the original low-voltage circuits and equipment are supplied

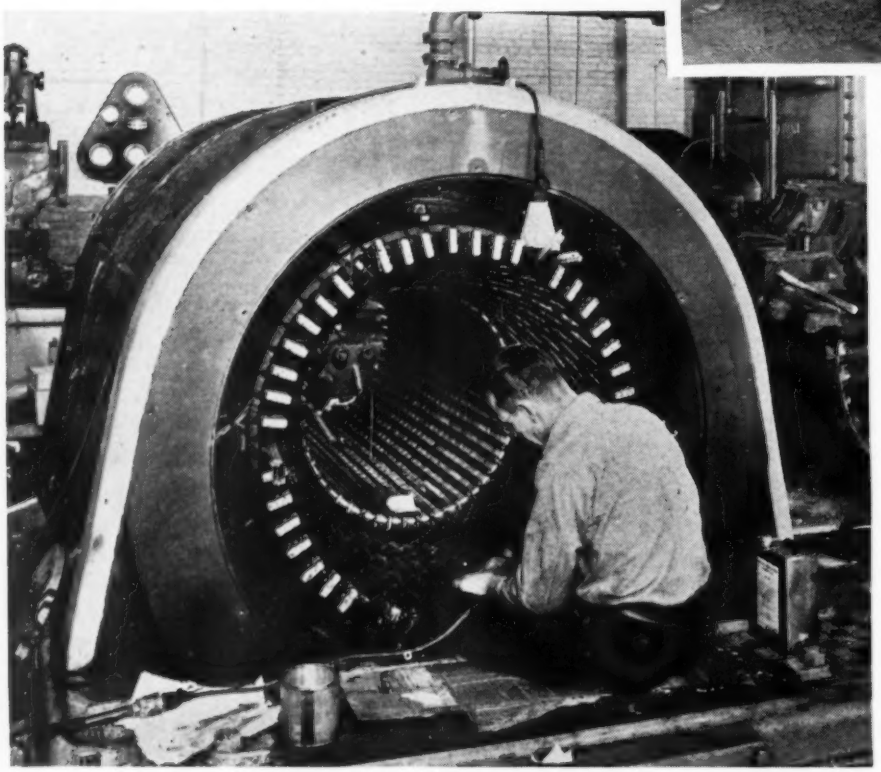


Fig. 8 (left)—The 5000-kva 600-v generator was rewound for 2400 v, the distribution voltage of the new system

generator's rating to 6100 kva. When the turbine was built provisions were made to add two extra rows of buckets later. This will give more power when needed.

Connecting the 600- and 2400-v buses through the old 1500-kva transformer increases the system's reliability and permits the power-generating units to operate for best economy.

The new 2400-v bus and switching equipment includes GE metalclad switchgear with 150,000-kva interrupting capacity. Mill power is supplied by 2400-v feeders to six GE 300- to 1500-kva unit substations at load centers, stepped down to 600 v. Changing from 600- to 2400-v distribution not only improved voltage regulation and reduced power losses in the feeders, but it brought the short-circuit and load currents within the ratings of moderate-sized circuit breakers.

Six indoor load-center unit substations were installed, Fig. 6 and 7. Each consists of a 3-phase 2400- to 600-v transformer with a box and disconnecting switch, left, and a switching section, right, with one low-voltage draw-out air-break circuit breaker. Transformers are noninflammable-liquid filled, instead of conventional oil filled, which permitted us to place the six substations most economically without regard for fire hazard.

Feeders from the substations run to busbars at switching centers. Connecting to these busbars are 42 inclosed air-break circuit breakers that protect an equal number of existing branch circuits in the mill. This arrangement required no change in mill wiring, motors, control and other equipment.

We experienced no difficulty in making the change during a 2-weeks' vacation in August, 1945. All equipment parts went together easily and quickly.

This new layout gives us a modern power system that has reduced voltage drop and power losses, and relieves congestion in the power plant. In addition the new equipment is much safer to operate. The new metalclad 2400-v switchgear, load-center unit substations and new 600-v switching equipment for the 2500-kva turbine at the powerhouse cost about $98,000. This includes $6000 for material to rewind the 5000-kva 600-v generator for 2400 v. Incidentally we salvaged several tons of old feeder and bus copper from the changeover.

THE FAILURE OF "FACT-FINDING"

THE PRESIDENT has asked Congress to grant him authority to appoint fact-finding boards to deal with nationally important labor disputes. Most citizens would like to see some reasonable and objective solution of the industrial strife that now is disrupting reconversion. Unfortunately, the record of the "fact-finding" procedure indicates that any claim of impartiality for this process is a gross misrepresentation.

The Administration bill would authorize the President to appoint such boards in cases certified to him by the Secretary of Labor. Each board would report to the President "its findings of fact and such recommendations concerning the dispute as the board deems appropriate." Its facilities and staff would be provided by the Secretary of Labor. The bill provides for an interval of not more than 30 days known as a waiting or "cooling off" period during which it would be "unlawful" (though no penalties are specified) for anyone to promote or encourage work stoppages.

Because the Administration did not wait for Congressional action upon its proposal, but appointed a number of fact-finding bodies to deal with current emergency cases, we have been afforded at least a partial preview of how the procedure may be expected to work out if laws establishing it are passed.

If the reports handed down by the fact-finding panels in the General Motors and oil disputes may be regarded as representative, it can be stated conclusively that Government-appointed "fact-finding" boards will concern themselves to only a minor degree with the establishing of facts. A far greater share of their effort will be concerned with the speculative business of forecasting future output and production efficiency and appraising the "ability to pay" of the companies involved. But the predominant emphasis will be placed upon framing recommendations for settling the disputes in line with announced Government wage-price policy.

In short, the procedure essentially will be one of registering with the public a government opinion as to how far wages may be raised in the cases at issue without raising price ceilings. Both the General Motors and the Oil Panels stated, in quite explicit terms, that this was their conception of the job assigned them.

"Fact-Finding" in Auto and Oil Disputes

As the General Motors Panel phrased it: "This board subscribes to, and has been guided by, the national wage-price policy" — which it summarizes as calling for wage increases to maintain take-home pay at wartime levels, to the degree possible without inflationary price rises.

The Oil Panel was even more forthright in the statement of what it was supposed to do. "In the judgment of the panel," it declared, "the earnings of the workers must be as high as is consistent with both the maintenance of the stability of the price structure and the provision for reasonable returns to the owners of industry." In other words, prices and the return to investors are to remain fixed, with labor entitled to an ever-increasing return up to the limit of what the traffic will bear.

Having thus outlined their respective conceptions of the job, each panel proceeded to carry out its mission.

The Automobile Panel recommended that General Motors increase its basic hourly wage rates by 19½ cents, which amounts to about a 17½ per cent increase on the company's average hourly wage of $1.12. The Oil Panel recommended an 18 per cent increase in basic hourly wage rates, or an additional 21 cents to the average wage rate of $1.20.

The General Motors recommendation was based almost exclusively upon the Panel's calculation that a 19½ cent raise would keep weekly take-home pay equal to that earned in 1944 when the work-week averaged 45.6 hours. The calculation turned on an estimate of what the effective work-week was likely to be in 1946.

The Oil Panel's recommendation appears to have been based on a more complex but no more conclusive accounting. After calculating that the maintenance of July 1945 take-home pay after 40-hour shifts were restored would require a 22 per cent increase in straight-time hourly wages, it recommended that an 18 per cent increase be made. It accounted for 9½ per cent of this by noting that this was needed to cover cost-of-living rises, and explained that the rest was justified by a combination of factors including loss of premium overtime pay, higher productivity, and settlements already negotiated. Since the Panel gave no indication of the weight given to these several factors, it may not be unfair to assume that the last-named was given preponderant importance, since 18 per cent was the increase already granted in collective bargaining by Sinclair and certain other oil companies.

Higher Pay Without Higher Prices

Both panels stated that the pay increases recommended could be met without raising price ceilings, but neither documents its case on this score with very conclusive "facts".

The Oil Panel confined its observations on this account to the statements that only one company in its group had pleaded "inability to pay" and that the industry was in a generally profitable position during 1943 and 1944.

The Automotive Panel stated that, under a number of assumptions about the 1946 operations of General Motors which it believed to be valid, the Company would have higher earnings than it had in 1941, its previous record year. It specifically stated that its findings in the case were not applicable outside the

automobile industry, but it recognized that the General Motors settlement would more or less determine the settlements of other automotive companies. It stated that it had not been able to arrive at a clear conviction as to the ability of other auto makers to pay similar wage advances, but it dismissed the issue by observing that they could expect to operate at full capacity in 1946, and that this should provide savings to offset the increased wage expenditures.

From the management point of view, one of the most serious limitations in the panels' procedure was their failure to deal with any of the Company claims put forward. In ordinary collective bargaining the demands of both sides are advanced and concessions in one direction are traded for concessions in the other. Here, although the companies involved had insisted upon their need for guarantees against contract violations and wild-cat strikes, and for other union concessions, nothing but the wage issue was considered by the "fact-finding" bodies. The General Motors Panel specifically recommended that the wage increase of 19½ cents be granted, but that otherwise "the status quo prevailing before the strike be restored by the reinstatement of the 1945 contract between the parties." Handled thus, fact-finding becomes indeed a wholly one-sided exercise.

Both panels accepted, quite uncritically, the general position taken by Government spokesmen that wage increases are inflationary only if they are directly translated into price advances. It should be obvious that all wage increases add to the inflationary pressure, if made at a time like the present when consumer purchasing power far outstrips the volume of goods and services available to satisfy it.

"Fact-Finding" Dodged in Steel and Rails

It is ironic, too, that even while the Automotive and Oil Panel groups were holding the "government policy" line, the President and his Reconversion and Stabilization Directors were busily at work trying to dent it. In the steel dispute, although price rises in this industry have a particularly sharp inter-industry impact, hearings by the appointed fact-finding board were deferred while negotiations were carried forward by the President and his advisors under which the industry was offered a price increase of approximately $4.00 a ton on condition that U. S. Steel and the United Steelworkers agree upon a mutually acceptable wage boost. It is hard to avoid the cynical conclusion that wage increases constitute the major administration policy, and that the principle of not translating them into increased prices is sacred only in those cases where there can be some reasonably plausible showing that wages may be raised without price advances.

Much the same general conclusion — that the "facts" are controlling only if they support a substantial wage increase — is sustained by the history of the administration of the Railway Labor Act of 1926, often cited as a glowing example of how "fact-finding" by so-called Emergency Boards of Presidential appointees has served to prevent strikes on the railroads. It is true that reports of almost all of the 31 Emergency Boards appointed to look into threatened railway strikes in the 20 years since the act was passed have provided the basis for a settlement of the disputes in question. The fact — a real fact — remains, that in 1941 and again two years later the wage adjustments found appropriate by Emergency Boards in major railway labor disputes were revised upwards at the White House after the unions involved rejected them as unsatisfactory and threatened to strike. The second upward revision was made after government seizure of the railroads to prevent a national transportation tie-up. When the "facts" did not indicate a large enough wage increase to satisfy the union and the Administration, the "facts" went out the window.

It would be irresponsible to deny the importance of finding some tenable solution of current disputes that threaten to completely disrupt the reconversion process. But upon the evidence of experience, "fact-finding" boards cannot be expected to operate according to the common conception of their function — as agencies designed to sift out for the public an objective and significant weighing of the facts behind conflicting claims.

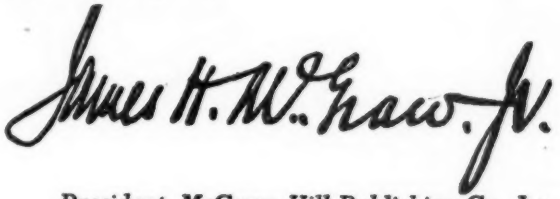
Without Principles Facts Mean Little

Facts, if they are assembled upon a sufficiently partisan basis, can be made to document almost any case one wishes to establish. The major difficulty in marshalling facts to resolve wage disputes is that there are no agreed-upon principles to determine the levels at which wages should be set. In the absence of such principles, it is inevitable that "fact-finding" boards, appointed by the Administration, manned largely by those who helped develop and administer Administration wage policies, and depending for technical assistance upon Administration Departments, will serve merely to implement Administration wage policy.

If Government means to reassert its wartime authority to fix wages — an objective specifically disavowed by the President and seemingly wanted by no one — it should accept the responsibility directly, rather than operate to that end through "fact-finding" boards which are independent in theory, but which cannot be so in fact.

The failure of the brand of "fact-finding" now urged upon Congress by the President is evident. Therefore, we must look for a solution along other lines.

What is needed is for labor and management to agree upon the principles that should govern the determination of wages under free collective bargaining. When such agreement is reached, then and only then, can fact-finding become an objective and useful instrument for settling wage disputes.



President, McGraw-Hill Publishing Co., Inc

How Hydraulic Axial Thrust Is Balanced In Multistage Centrifugal Pumps

Many impeller arrangements in multistage centrifugal pumps balance hydraulic axial thrust but they are all compromises. Alexander Brkich, engineer with Ingersoll-Rand, shows how they fail to do a 100% job and why a thrust bearing is needed even when hydraulic axial thrust is theoretically balanced

▶ BALANCING HYDRAULIC AXIAL THRUST in multistage pumps is more complex than in single-stage units, discussed in the January number, page 78. Because of the number of factors to be satisfied all multistage axial-thrust balancing methods are compromises. While one scheme may have a distinct superiority in one respect, it may not be so good as another from a different viewpoint. As a result, there are at least three different basic approaches to the problem with a number of variations of each.

Simplest multistage arrangement uses single-suction impellers in series so that the flow moves progressively from one end of the pump to the other, Fig. 1. This gives the simplest casing possible. Since all impellers face in the same direction, the resultant thrust is the sum of all unbalanced forces acting on each stage and is directed toward the suction. To maintain axial balance a balancing device is needed. But before considering it, let's examine the characteristics of the series arrangement.

Impellers in Series

Pressure difference between stages, points *A* and *B* in Fig. 1, which induces interstage leakage, is less than that developed by one impeller. Tests seems to indicate that the head is about half that developed by the impeller, and may be slightly more when operating in normal-capacity range. If we denote one-stage pressure by *P*, discharge pressure at the third stage is $3P$, and at *A* behind the impeller the pressure is about $2\frac{1}{2}P$. On the other side of the throttling bushing at *B*, pressure in the fourth-stage eye is $3P$. Consequently, pressure difference between stages is equal to only half of one-stage pressure, and not much improvement is possible in reducing internal leakage.

Suction pressure acts upon the stuffing box on the pump's low-pressure end. At the other end, pump pressure would be nearly full if it were not reduced. This can be done by a chamber *C* ahead of the stuffing box, vented at *V* back to the suction or some other low-pressure point. Leakage from the last stage to chamber *C* is suitably throttled. This method has the advantage of not only reducing the stuffing-box pressure, but also creating the pressure difference required for operation of the balancing device, as will be explained later in this article.

Simplest form of balancing device is a cylinder, or balancing drum, rotating with the shaft between the last-stage impeller and the balancing chamber. To throttle the leakage, a close radial clearance is mainained between the rotating drum and the mating stationary part in the casing, Fig. 2. Because of the pressure difference between the drum's faces, a force is developed equal to the product of the radial area and the pressure difference. Direction of this thrust on the balancing drum is away from the pump's suction end. By varying the drum's diameter, the balancing thrust can be almost any value.

If pressure at the impeller's back hub were the same as at its periphery, the rotor could be completely balanced at all capacities by making the balancing-drum area equal to the unbalanced area of one impeller. However, pressure distribution around an impeller is affected considerably by rotation, being appreciably less at the back hub than at the impeller's periphery, thereby reducing the hydraulic thrust. For this and other reasons balancing-drum area must be smaller than the unbalanced area of an impeller to balance the hydraulic axial thrust.

Because of pressure distortion due to rotation, hydraulic axial balance can be attained for only one condition with a given drum diameter. At any other capacity, there is definite axial thrust in one direction. Because of local pressure drops around the impellers the ratio of pressure differences acting on the impellers and on the drum does not remain the same for different capacities. If the point of hydraulic axial balance is best efficiency, then residual thrust is toward the suction at low capacities, and in the opposite direction at higher capacities. Conse-

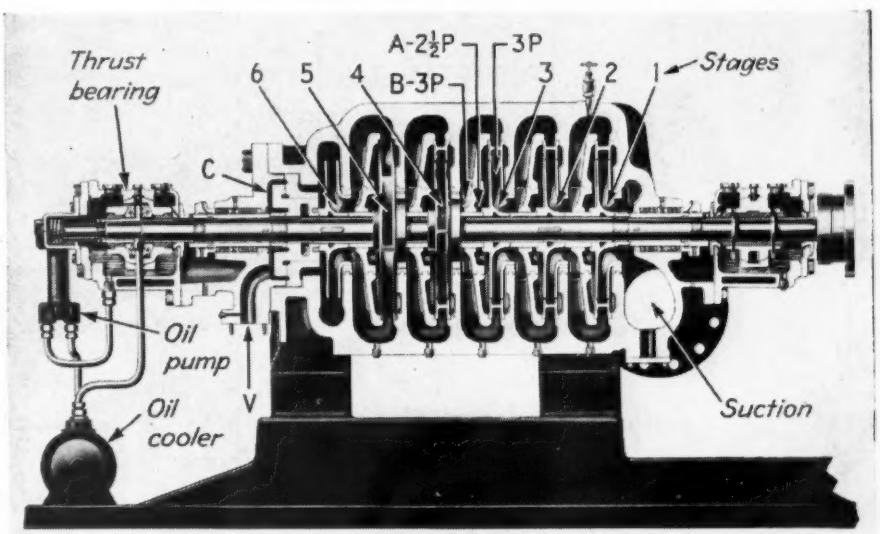


Fig. 1—Multistage centrifugal pump with six single-suction impellers, all facing in one direction so that flow is progressive from one end of the pump to the other

quently a thrust bearing is provided to handle this load.

Since the balancing drum is a throttling device, it must permit a certain leakage by it. Not very much can be done to reduce this leakage if the simple design is retained. Wear enlarges the clearance and thus increases the leakage. To throttle it more effectively, clearance around the drum can be reduced to the minimum that is permitted by danger of seizure between the drum and the stationary surface inside of which it rotates. Increasing the drum's axial length would also be beneficial, particularly in avoiding wear, but to do this, pump length would also have to be increased by a similar amount. Accordingly, as a compromise the drum is given a reasonable length without unduly increasing that of the pump.

When pumps operated at 1750 rpm or less and pressures were not so high as now, axial unbalance of the simple balancing drum was not excessive at different capacities and a thrust bearing of reasonable size was sufficient. For 3600-rpm multistage pumps the balancing drum proved inadequate and more complete balancing of hydraulic axial thrust became necessary. As a result, the balancing disk came into use.

A balancing drum cannot balance hydraulic axial thrust at all capacities because pressure differences acting across the drum faces cannot be controlled. This disadvantage is overcome by a balancing disk, Fig. 3. Main differences between the balancing drum and disk is that leakage is throttled through an axial clearance in the latter. It is mounted on the shaft and the mating face is in the casing so axial clearance between them can be varied easily by a relatively small axial movement of the rotor to control the leakage.

Pressure on face *D* is less than discharge, as previously explained. At the outer edge of the clearance and along face *B*, pressure is the same as in the balancing chamber. To vary this pressure an orifice is inserted in the vent line to the suction, or a throttling device controls leakage from the balancing chamber into another at suction pressure.

Fig. 3 shows how the balancing disk operates. The force on face *B* is equal to balancing-chamber pressure times radial area of the disk, acting to close the axial clearance between the disk and stationary face *C*. At *C*, the effective pressure is some mean between that at *A* and in the balancing chamber. This force tends to open the clearance. Therefore, when a hydraulic thrust is imposed on the shaft to move it to the right, axial clearance increases. This permits more leakage to the balancing chamber and its pressure increases to push the disk back because of the increased throttling in the vent line to the suction. Eventually, a setting is established at which the forces on faces *C* and *D* equal that on *B* and the hydraulic thrust on the rotor is in axial balance.

Although the pump's rotor must have axial freedom so the balancing disk can seek its own setting, it is necessary to protect the pump by limiting this travel. Under certain abnormal conditions or with sudden capacity changes, the rotor is likely to exceed its normal range of movement. If it is toward the right so that the axial gap opens, there is nothing to stop the rotor except when the impellers hit the casing and serious damage may then result. Continuous operation in this position would also cause excessive leakage. Movement in the opposite direction would bring the disk face in contact with its mating stationary one and cause their faces to be scored. Prolonged contact would ruin the parts, so this danger is avoided by limiting rotor travel in the thrust bearing.

Effects of wear on the balancing disk's performance depends on what type of secondary throttle is used. If it is an orifice in the vent line, wear takes place at the disk face only. This is automatically remedied, however, by the rotor moving to the left to maintain the original range of clearances and avoid affecting the hydraulic balance.

Bushing Throttle

On the other hand, if a bushing throttle or some similar device with radial clearances is used, both disk face and throttle wear. As radial clearance of the throttle increases, its throttling effect on the leakage is reduced and as a result a greater amount of leakage is needed to maintain hydraulic axial balance. Once begun, wear tends to accelerate because the percent of leakage increase for hydraulic balance is greater than the percent of increase in radial clearance. The greater velocity head has a greater erosive action and wears the clearance more rapidly.

Compared to a bushing throttle, an orifice has the disadvantage that the pressure acting on the stuffing box, adjacent to the balancing chamber, varies. When the hydraulic thrust is low, this pressure may be considerable and cause packing trouble. A bushing throttling device eliminates this difficulty because there are two separate chambers. Variable pressure is confined to the chamber around the disk and throttle, while pressure in the chamber next to the stuffing box is easily maintained at suction value.

Although the balancing disk is an improvement over the simple balancing drum in maintaining hydraulic axial balance at all times, its leakage is quite high. By combining the drum and disk, Fig. 4, however, more throttling surface is gained while automatic hydraulic balance is retained. At the same time variable pressure in the balancing chamber is eliminated. In this arrangement the axial clearance between the disk and sta-

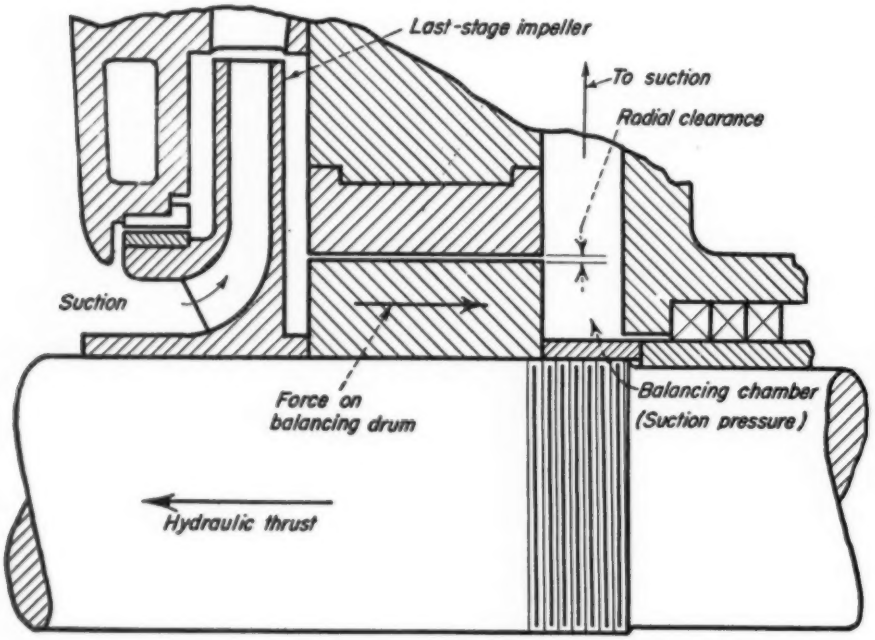


Fig. 2—A balancing drum fixed on the impeller's shaft is the simplest form of device for balancing the hydraulic axial thrust in multistage centrifugal pumps

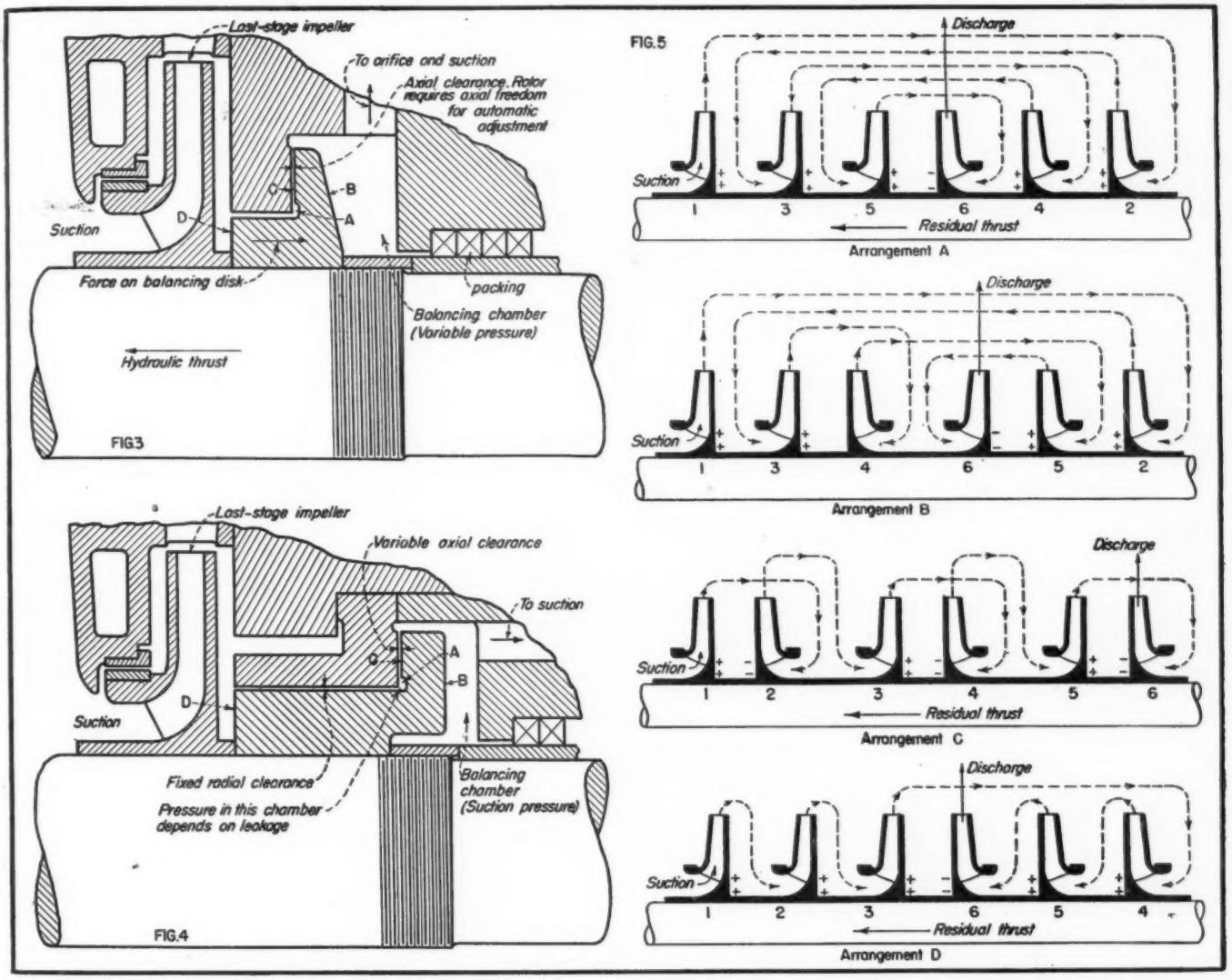


Fig. 3—A balancing disk fixed on the impeller's shaft can maintain axial-thrust balance at all pumping capacities. Fig. 4—Flanged balancing drum that combines the features of a balancing drum and disk. Fig. 5—Four opposed single-suction impeller arrangements to obtain hydraulic axial balance. A and B give lowest pressure on the stuffing-box

tionary surfaces still controls the leakage. However, intermediate pressure for automatic balance is determined by the friction loss of flow through the radial clearances to annular chamber *A*.

Operation sequence with the drum-and-disk balancing device is the same as with the disk alone. Because of hydraulic axial thrust the pump's rotor tends to close the disk's axial gap to cut off the leakage. A decrease in leakage through the radial clearance of the drum reduces the friction loss in this path so that pressure at *A* rises. This increases the average pressure on the disk face to add to its clearance. Ultimately, the rotor finds a position where the hydraulic axial thrust and the force on *B* counterbalance the forces on faces *C* and *D* to put the rotor in axial balance.

While most balancing devices operate satisfactorily with single-suction impellers in series, they do have inherent shortcomings that cannot be entirely eliminated, their seriousness depending on the actual design. The high pressure differential across the balancing devices causes considerable leakage to return to the pump's suction, as previously mentioned. The high pressure differential also means rapid wear of the balancing device's throttling surfaces if they are not long enough. Use of proper materials reduces wear of these parts. Since the balancing devices must be placed between the last stage and its adjacent stuffing box, they increase the pump's over-all length.

Occasionally leakage flashes to steam as it passes through the balancing device when the pump operates at partial capacity. Seriousness of this danger depends on how close the liquid's temperature is to the boiling point.

As the liquid passes through the pump, its temperature increases by an amount determined by how close operation is to shutoff. When the last stage is reached, liquid temperature may be so high that part of it flashes to steam as it escapes to the low pressure of the balancing chamber. When this happens, the liquid that has flashed occupies a larger volume than before and its velocity through the clearances increases proportionately. This higher velocity adds to the erosive action of the leakage and may damage the throttling surfaces unless they are made of suitable materials.

The simple arrangement of pump parts possible with balancing devices, compensates to a great extent for the disadvantage mentioned. Effects of pressure breakdown are localized because it is confined to one set of parts at the pump's discharge end. Also, these parts are usually replaceable without dismantling the entire pump.

To eliminate balancing devices, hy-

draulic axial thrust is frequently balanced by opposing single-suction impellers in equal groups so the thrust of one neutralizes that of another. Success of this method depends on the impeller arrangement, and to what extent the various factors previously mentioned are satisfied. Although a great number of combinations and arrangements of stages are possible, only a few are worthy of consideration. Fig. 5 shows some of the commoner ones.

With opposed impellers, the most important factors are stuffing-box pressure, interstage leakage and casing design. To satisfy these conditions, the first and second stages are placed next to the stuffing boxes to have the lowest pressure on them. To keep interstage leakage at a minimum and to have the simplest casing arrangements the stages must be in series. Hydraulic balance requires that one half the stages face opposite to the other half. Unfortunately, because no stage arrangement satisfies all these conditions simultaneously, each arrangement must be a compromise that favors some particular points.

Impeller Arrangements

In Fig. 5, arrangements *A* and *B* have the first and second stages next to the stuffing boxes, and give low pressure on them. To obtain this feature and have an equal number of opposed impellers requires long passages to carry the liquid in the right sequence between stages. Pressure causing interstage leakage is the pressure of one or two stages depending on the location along the rotor.

With arrangement *C* pressure between stages is never more than that of one stage. But the pressure next to one stuffing box is only one stage less than full-discharge value. Therefore, a breakdown throttling bushing, which is a balancing drum with the diameter reduced to avoid the development of a thrust, is used to reduce the pressure. The scheme partly defeats its purpose and the passages between stages are also rather involved.

Arrangement *D* attempts to combine the simplicity of a series-arrangement *C* with the opposed-impeller principle, *A* and *B*. However, this scheme requires two throttling bushings; one in the middle of the rotor and one at its high pressure end with one-half discharge pressure acting across each. Even though these bushings increase axial length and leakage, this method has the advantage of being usable for vertically-split-barrel pumps because of casing simplicity.

If the throttling bushings between stages were a perfect seal, the net pressure differences across each impeller would be identical and the resultant hydraulic axial thrust of one half of the impellers would be equal and opposite to that of the other half. Unfortunately, there is no perfect seal so in practice there is leakage from the higher- to the lower-pressure side of stage bushings. This leakage partly upsets the hydraulic balance and creates a residual thrust.

Magnitude of this thrust depends on the bushing-clearance, pressure differences across them and the way the individual thrusts are affected. In Fig. 5, arrangements *A*, *C* and *D* give a residual thrust toward the first stage. With arrangement B, effects of pressure distortion are practically equal in both directions; consequently, the initial hydraulic axial balance should not change much. Because complete balance is seldom attained even when an equal number of stages are opposed, a bearing is provided to take the residual thrust, which increases with wear in the running clearances.

Double-suction impellers, or single-suction ones with back rings, are also used to balance hydraulic axial thrust. With this method unbalanced pressures that create thrust can be eliminated.

While a double-suction impeller for the first stage might be desirable because a lower net-positive suction head can be used, there is no hydraulic advantage in using such an impeller for succeeding stages except in unusual instances. The double-eye entry required at each stage makes casing passages complicated, and any other arrangement except one with the stages in series becomes difficult to manage.

To avoid high pressure on the stuffing box, a throttling bushing must be used, which increases pump length. Double suction for each stage also increases it. A pump with double-suction impellers is 9% longer than one with single-suction impellers arranged as in Fig. 1 and 23% longer than arrangement *A* in Fig. 5, all of comparable capacity. Therefore pumps with more than three stages seldom have double-suction impellers. Fig. 7 shows a typical 2-stage pump with them.

Internal leakage in pumps with double-suction impellers is greater than for an equivalent one with single-suction impellers in series. In Fig. 1, pressure difference between stages is about half of one-stage pressure. With double-suction impellers, the difference is full-stage pressure with a resultant greater leakage.

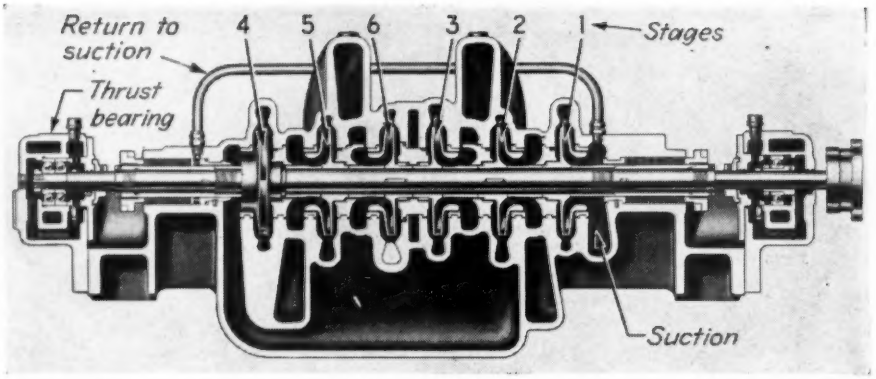


Fig. 6—Multistage centrifugal pump with six single-suction impellers, three facing in one direction and three in the other to obtain hydraulic axial balance

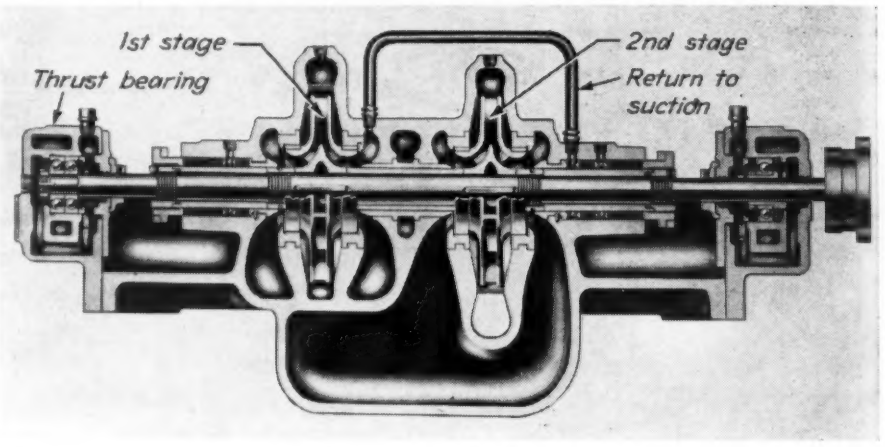


Fig. 7—Multistage centrifugal pump with two double-suction impellers in series to obtain hydraulic axial balance and eliminate thrust on the impeller's shaft

THE OPERATING ENGINEER

George Edwards *Advisory Editor*

PRACTICAL AIDS · MAINTENANCE HINTS · QUESTIONS — ANSWERS

PUBLISHED MONTHLY AS AN INTEGRAL PART OF POWER

Refrigerant Cannot Escape From a Flawless Pipe Joint

Since an engineer's main responsibility is to keep both the liquid and vapor confined inside of a system, George Holman tells how leaks occur, what can be done to prevent them, and how to handle a plant when a receiver connection has failed at the joint*

▶ PHYSICAL CONSTRUCTION and layout determine the method to use in making a system tight because the refrigerant circuit contains many pieces of equipment, each of which has several potential sources of leaks. They can occur at: (1) welds (2) rolled-metal joints (3) metal unions (4) screwed joints (5) gaskets (6) packing glands.

Relationship of refrigerant leakage to the type of joint and to operating conditions may be better explained by studying a plant I operated several years. It contained a common receiver and condenser that served three separate low-pressure systems, each having its own compressor. Installed in 1935, the plant was charged with 2000 lb of ammonia and, after ten years' continuous operation losses through leaks, air purging and oil blowdown combined have been less than 5%.

There are about 3000 places where leakage is theoretically possible. During installation, 1163 welds were made, mostly on field-assembled evaporators and return lines. Under test pressure of ammonia-scented air at 150 psi, not a single weld showed a leak. Nor has any appeared since. In the shell-and-tube condenser, or vapor desuperheater in the hot-gas line, not one of the rolled-tube ends leaks. Although the small feed tubes of the compressor lubricators have all been removed several times, the union joints are still tight and serviceable.

The piping contains about 1000 screwed joints, exclusive of machine plugs and valve bonnets. These were cut and assembled by two pipe fitters experienced in erecting steam and water lines, but without any experience whatever in assembling a refrigerating system. Installation tests with ammonia-scented air at 250 psi revealed 44 leaks, 18 of which were serious. Repairing them required breaking and remaking 127 joints. Principal cause of the threaded-joint failures was the pipe fitters' inexperience. After discussing the job with them, I found that each of the following specific causes had contributed to the failures:

1. Factory-threaded ends of pipes, threads scarred or damaged in shipment, had been installed without re-chasing.

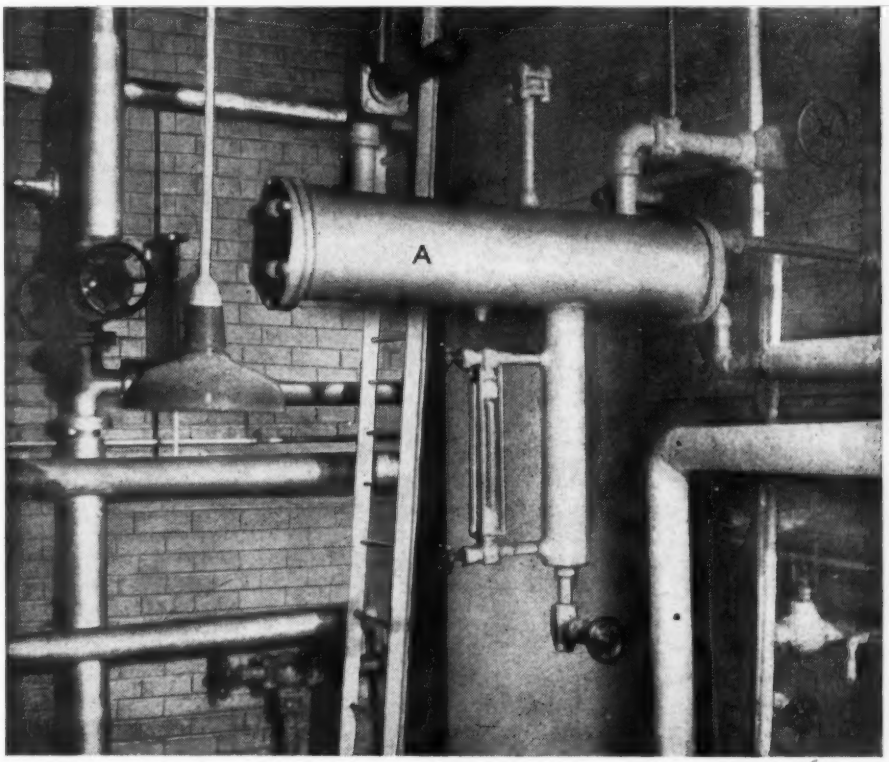


Fig. 1—After ten years of continuous operation, the combined losses through leaks, air purging and oil blowdown have been less than 5% of the original charge

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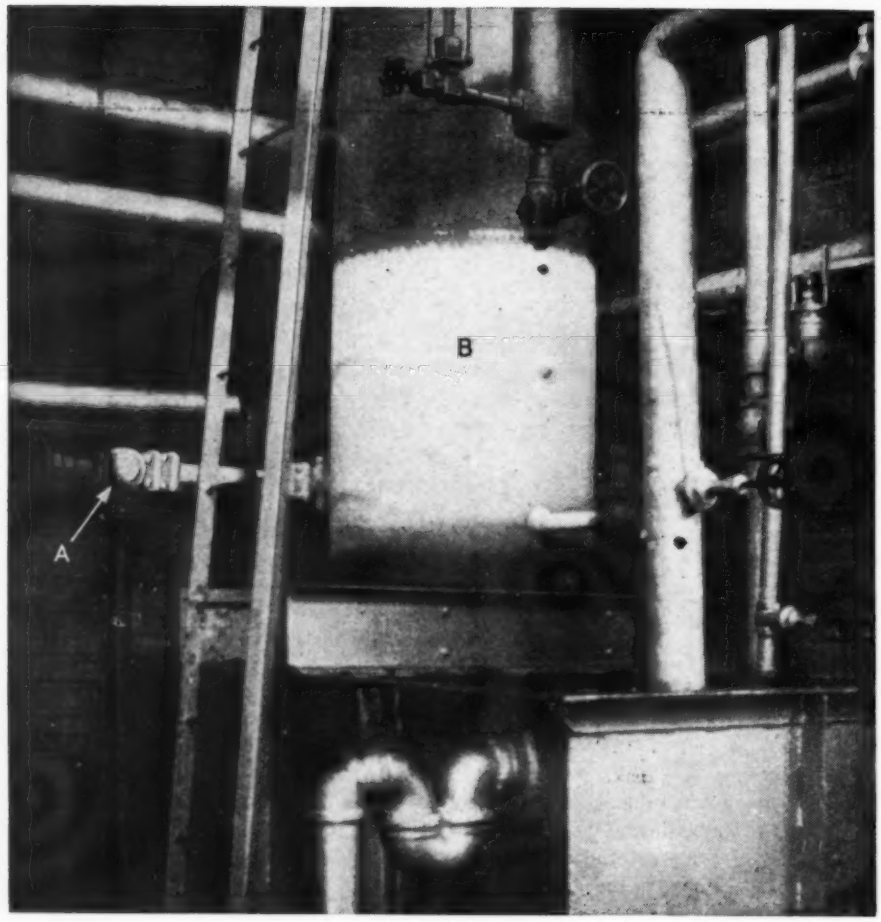


Fig. 2—When cooling water was shut off to prevent ice forming in the condenser tubes and the condenser pressure was lowered, frost B indicated the liquid level

2. Pipe near threads had been squeezed out-of-round in a vise.
3. Pipe was threaded too far.
4. Threads were cut too deep and tightened only against a fitting shoulder.
5. Threads were cut with dull dies.
6. Malleable fittings were warped.
7. Threads in fittings were scored.
8. Threads had not been cleaned of cutting chips and fluid before assembly.
9. Assembly had been made without sealing paste or lubricant.
10. Water and steam lines were assembled concurrently, and red lead had occasionally been used in place of glycerin-mixed litharge.
11. Litharge was not mixed properly.
12. Litharge had become granular before mixing.
13. Litharge contained foreign matter.
14. Joint had been backed off to make flange holes meet.
15. Joint had been tightened farther after litharge had set.

Our practice is to use sheet-lead gaskets in male and female connections on compressor cylinder heads and asbestos ones in bonnets of stop valves, thermostatic expansion valves, pipe flanges and compressor cover plates. For thermostatic expansion valves and common sizes of pipe flanges, we purchase ready-cut gaskets from the manufacturer. Odd sizes are cut as needed from material sold by reliable dealers. If the company trademark is not legible, we examine the material closely and check each gasket with micrometers for variations in thickness.

Packing on compressor crankshafts and in valve-stem stuffing boxes is carefully adjusted. Because most of the 139 ammonia valves backseat, they rarely leak. A normally closed or frequently used valve sometimes leaks at the stem especially if the packing becomes hard. Also, valve stems sometimes leak when pressure is restored inside the system after a pumpdown to sub-atmospheric pressure. Reversal of pressure between inside and outside of the system caused leakage at the shaft packing of one compressor in particular. After tightening several times we removed the packing and found the oil lantern ring had been placed at the bottom of the stuffing box.

Gasket joints, whether lead or asbestos, remained practically unaffected by wide changes in pressure, or of pressure reversal. Crankcase pressure varied from a 26-in. vacuum to 100 psi without leakage except that the oil gage-glass packing leaked under the higher pressure. Of the two most serious leaks one occurred through the gage-glass seal on the large compressor, and for a few seconds approached the nature of a blow.

While they held well through wide pressure changes, lead gaskets under the compressor cylinder heads often leaked when cooled rapidly by liquid ammonia expanding back to the machine. On one occasion this might have been dangerous. When the operator tested for the leak with a lighted sulphur taper, the mixture of ammonia and oil caught fire and a flat thin canopy of flame spread across the operating room.

A leak in a connecting line, between the receiver shell and the first valve at which the line can be cut off, presents a serious problem to the operating engineer. In many plants it means a long pumpout of both condenser and receiver. This interruption to service may mean a critical temperature rise that endangers stored products.

If the leak is in the nature of a blow, it may be necessary to reduce the vapor pressure of the receiver liquid by reversing the compressor's manifold valves at once. But if the leak is not serious, or if the receiver is emptied for some other purpose, the job can be done quicker by maintaining normal flow direction. In most systems it can be presumed that all liquid has left the receiver during a pumpout only when a pressure of 25 psi or less reveals no frost formation on receiver at the low points, *D*, Fig. 3.

Emptying the Receiver

The time required to empty a receiver depends upon: (1) quantity of refrigerant in the system (2) percentage of the charge in the receiver as liquid (3) relative volumes of the receiver, condenser and evaporators (4) compressor displacement (5) type and capacity of expansion valves. If the evaporators have ample capacity, are not normally flooded and are not fed by low-pressure float regulators, the quickest way to empty the receiver is to open manually operated expansion valves wide and throttle the return valves to prevent liquid flow to the compressors. Top-fed evaporators must have the return valves closed more than those fed from the bottom. A thermostatic expansion valve passes liquid slowly because it has a smaller orifice.

If the evaporators operate flooded, and refrigerant expansion is controlled by a high-pressure float regulator, the receiver, if present at all, operates almost empty unless the system is overcharged. When

either a dry or flooded system is overcharged, it may be necessary to store part of the refrigerant in the condenser. If the equalizer line taps into the condenser top, considerable liquid refrigerant may be stored in the latter by keeping discharge pressure on the liquid in the receiver by way of the equalizer line, and operating the system normally. The refrigerant then flows from the receiver through the system and back to storage in the *condenser.*

Collecting Refrigerant

To collect refrigerant in the condenser, close the stop valve in the liquid line between this vessel and the receiver and leave the equalizer-line valve open while condensation continues in the condenser. It may be necessary to use more or colder condensing water to keep the discharge pressure under safe limits. Air and other noncondensable gases add to the discharge pressure, and their partial pressures are increased by the rising liquid level. Thus, when storing refrigerant in the condenser keep the system purged.

Here is how we pumped out a receiver to repair a gas leak that developed at *A*, Fig. 3. Since the leak appeared unlikely to become worse, the operator closed liquid-line stop valve *A*, Fig. 2, adjacent to the condenser. Equalizer-line valve *B*, Fig. 3, and master liquid stop valve, leading to the evaporators, were left open. While the compressor continued to operate normally, he opened the expansion valves wide, throttled the return valves and partly closed the compressor suction valve to protect the compressor against liquid carryover.

As liquid left the receiver (indicated in gage glass C, Fig. 3) it accumulated in the condenser to an unknown height, presumably up to the equalizer outlet. Forward flow of the refrigerant was continued, however, without undue pressure rise. A quarter hour after liquid disappeared from the gage glass it was presumed to have passed into the evaporators and only vapor remained in the receiver. The master liquid stop valve was closed, and refrigerant flow at the compressor reversed by opening the pumpout and bypass valves, and completely closing the suction and discharge valves.

The cooling water was shut off to prevent ice forming in the condenser tubes, and within a few minutes a sweat line formed on the condenser. As its pressure fell, frost formed on shell *B*, Fig. 2. Frost on receiver *D*, Fig. 3, showed that it still contained some liquid, and that 15 minutes after disappearance from the gage glass was not time enough for all liquid to leave the receiver. This was evaporated under high vacuum by turning cold water from the condenser over the receiver. Equalizer-line valve *B*, Fig. 3, was then closed and the receiver opened for repairs.

Summarizing our experience in this plant indicates that the following recommendations during installation can minimize trouble from leaks:

1. Make ammonia-pipe welds 50% thicker than the parent metal.
2. When welding with an oxyacetylene blowpipe, take care not to carburize the weld especially on the evaporator pipe. Such a weld may be brittle when extremely cold.
3. Cool an electric arc-weld slowly, or anneal it.
4. Break metal unions only when unavoidable.
5. If possible, use only block dies to cut pipe threads and be sure the dies are sharp.
6. Clean pipe threads immediately after cutting.
7. Spin tap into all fitting threads.
8. Use only a thick paste of litharge and glycerin on ammonia pipes. Mix the paste just before assembling the joint, and use within a few minutes. When not in use, keep glycerin bottle and litharge can tightly closed.
9. Put litharge paste on pipe threads only, not inside fittings.
10. Position pipe while litharge is still fresh, as it loses most of its value as a seal if the threads are turned after it hardens.
11. During assembly, a threaded connection should not suddenly become difficult to turn, but tighten gradually.
12. Keep good gasket material handy in a dry place. Asbestos material may absorb water and become useless.
13. Put a little ammonia compressor oil on each gasket. This helps seal the joint against leaks, and prevents the gasket sticking.
14. When assembling shaft packing, be sure the lantern ring is positioned under the oil inlet to the stuffing box.
15. Saturate braided packing with oil before inserting in the stuffing box.

The following precautions pay dividends in better performance if they are observed during operation:

1. When going to open a valve usually kept closed, or to close a valve usually kept open, take a wrench to tighten the packing gland.
2. When blowing oil from the oil trap, condenser, liquid receiver, evaporator or accumulator, be sure internal pressure is as low as possible. When convenient, isolate the particular piece of equipment from remainder of system.
3. When pumping refrigerant back for repairs, remember that liquid may lie in pipes showing heavy frost, even with the system under high vacuum, until it absorbs enough heat for evaporation.
4. Unless absolutely necessary, never pump a high vacuum because it permits an excessive quantity of air to enter the system.
5. If the system has manually adjusted expansion valves, a sharp increase in head pressure during operation may prime or flood the compressor.

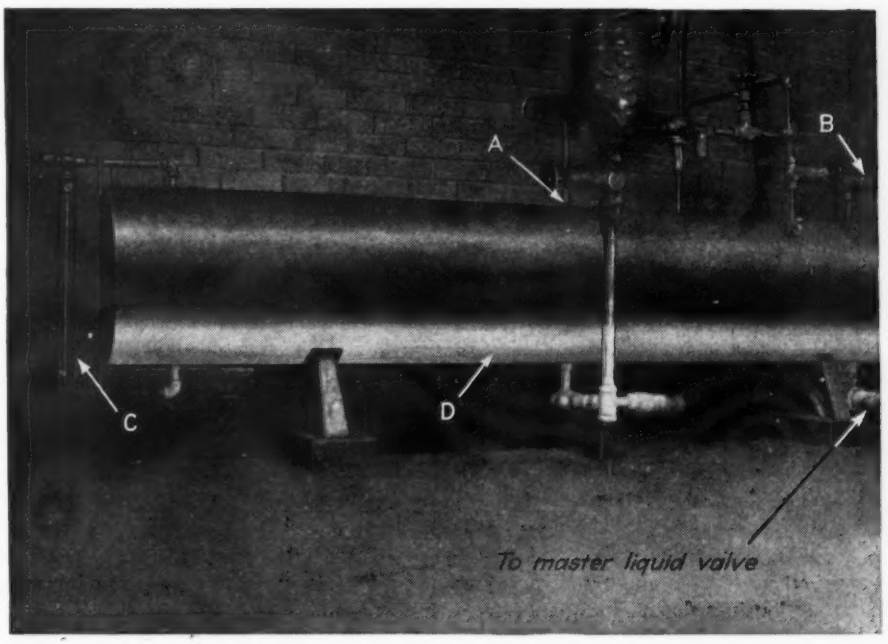
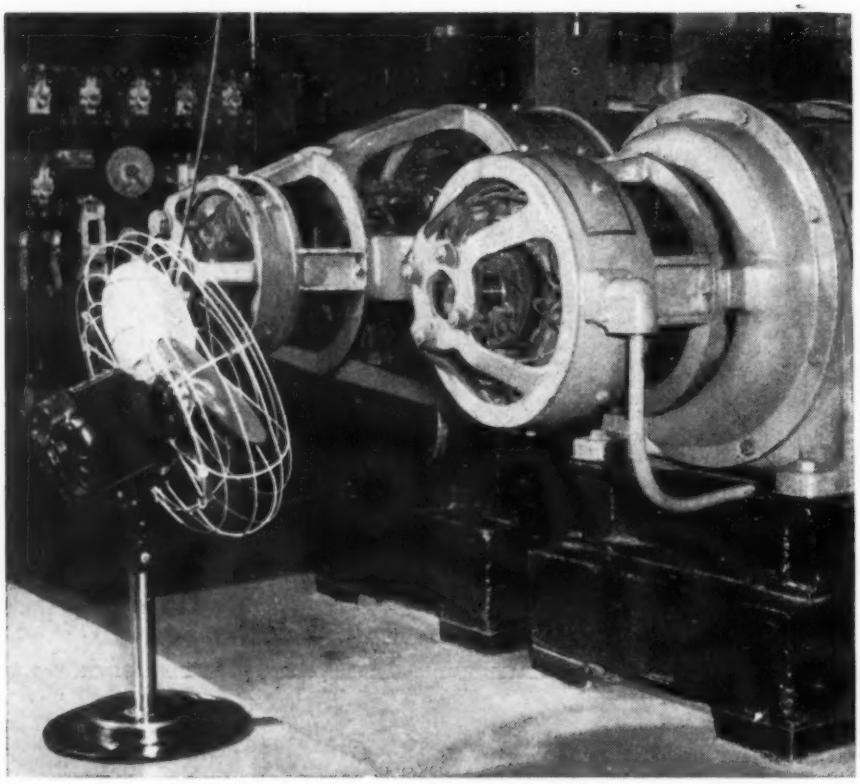


Fig. 3—Frost accumulation D on the receiver showed it required more than 15 minutes after liquid disappeared from the gage glass to empty the vessel

PRACTICAL AIDS TO OPERATION

Plant-Tested Methods and Ideas for Power Men



FANS COOL MOTOR-GENERATOR EXCITERS

IN SUMMER, temperature rises as high as 112 F in the express-elevator motor room of the McGraw-Hill Building. This caused excessive temperature of the motor-generator sets, particularly of their exciters. Increased resistance of machine windings due to high temperatures made it difficult to level the cars accurately at the floors. Also, to keep brushes and commutator in good condition required considerable attention.

After two exciter armatures burned out and had to be rewound we decided something must be done to reduce the machine's temperature. Using exhaust fans to circulate air from the outside through the motor room did not give us the relief expected. We then obtained a 20-in. fan and directed its discharge directly on the commutator of the exciter that had the highest temperature, as in the photo. Almost immediately there was a phenomenal drop in the machine's temperature. We then obtained fans for all the exciters and they have reduced the temperature of these machines to well within safe limits. We also use the exhaust fans in summer to circulate outside air through the motor room to remove as much heat as possible and improve ventilation.

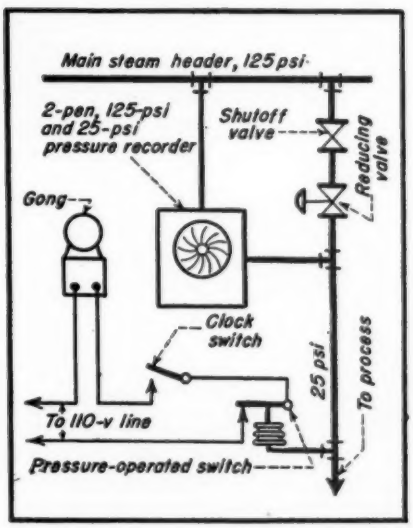
New York, N. Y. FRANK SCHLIEFF

Meters Performance Of Process-Steam Line

STEAM IN OUR PLANT is generated at 125 psi and reduced to 25 psi in the process-heating line. At the end of each working day the night watchman closes the shutoff valve in the process line. This insures that steam is shut off from all heated process equipment. At 6:00 a. m. on each working day the watchman opens the process-line valve. This allows two hours to heat the process equipment so that it is ready for operation when employes start work at 8:00 a. m. The system is ideal for our plant as long as the human element does not fail. When it did a few times I decided to provide the watchman with an automatic buddy.

To do this, I installed a 7-day 2-pen pressure recorder on the main- and process-steam lines as in the diagram. This recorder which shows the pressure in both lines and when steam is shut off from and turned into the process line, is a permanent check on the watchman.

To help him do his job I installed a time switch with its contact in series with a gong. This switch holds its contact closed for two hours and the gong rings for this period unless its circuit is broken. I break it automatically with a pressure-operated switch as in the diagram. If the watchman, who makes his last round at 4:00 a. m., has steam pressure up on the boiler at 6:00 and opens the process-line valve before the clock closes its contact, the gong does not ring. If he fails to do this he has some wild music until he gets the process-line valve open and pressure up on the boiler.



This arrangement has eliminated all our previous troubles with process heating because of failure to turn on the

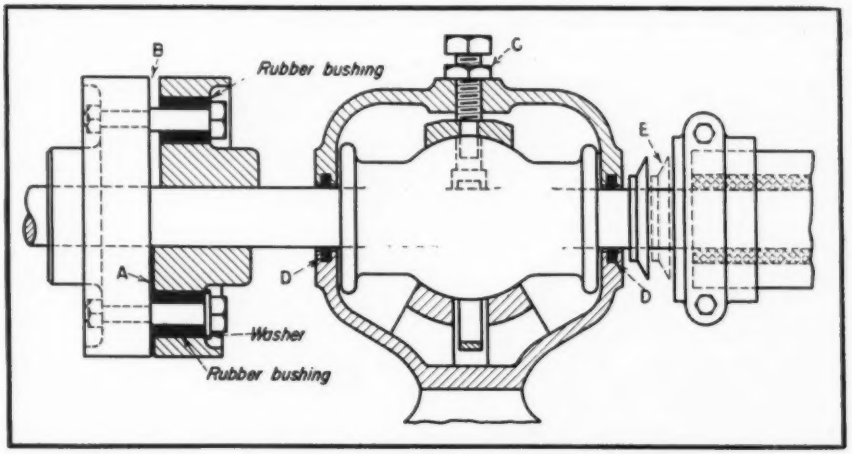
steam. At the same time it assists the watchman in performing his duties, giving a permanent record that they have been correctly done, and protecting him in case of complaint.

Englewood, N. J. R BOETTINGER

This Bearing Failure Strips Turbine Blades

A BEARING FAILURE on a 50-hp 3300-rpm turbine stripped the blades and did other damage. When making the repairs several bad operating conditions were discovered, one of which was the direct cause of the bearing failure and other troubles.

The rubber-bushed-pin flexible coupling was bolted up solid. The mechanic who installed the coupling had placed thick steel washers between each pin's head and the bushing and pulled the latter tight against the coupling's face. The washers were larger than the bushings so that when the pins were tightened they pulled the two halves of the coupling together, as in a solid one, *A* in the figure. The two halves should be separated as at *B* to permit the coupling to function properly and prevent vibration.



The bearing is self-aligning with a spherical seat and is prevented from rotating by a bolt through the cap. This bolt was tightened down hard on the bearing, which prevented it from aligning with the shaft, when it should have been only finger tight and held by tightening locknut *C* on the bearing cap.

When the bearing was assembled the felt seals at *D* were apparently lost and not replaced. This left considerable clearance between the bearing housing and the shaft. Water vapor worked through this clearance and condensed in bearing. The condensate in the oil was the direct cause of the bearing failure. Another condition contributing to water getting into the bearing was the position of the water deflector. This was placed near the bearing instead of at *E* near turbine-shaft seal in its casing.

Thorold, Ont. G BARRETT

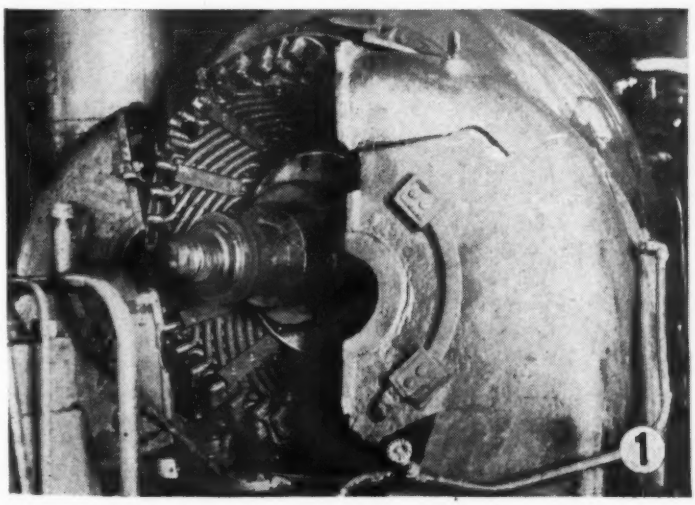
THIS TURBINE WRECKED—ALL FOR A FEW DROPS OF LUBRICANT

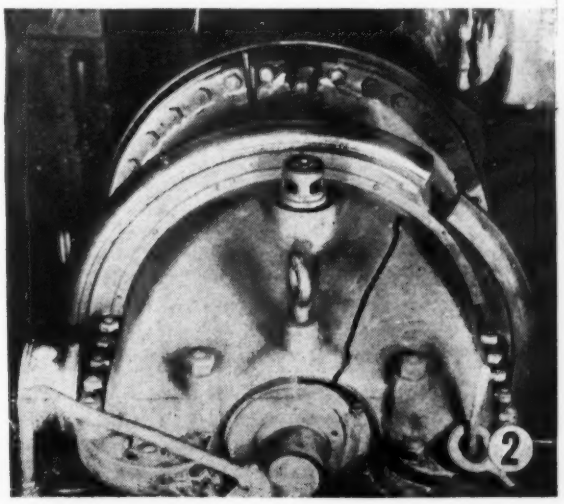
USUALLY lack of lubrication in a bearing has no more serious consequences than burning it or scoring the shaft. However, sometimes a bearing failure may completely wreck a machine. According to *The Locomotive*, this happened to a 3600-rpm steam turbine-generator coupled to a 780-kva alternator and geared to a 1000-kw dc generator operating at 514 rpm.

A powerhouse attendant, upon seeing smoke come from the bearing between the alternator and the reduction gear, ran to get the turbine operator. Before anyone could get to the machine to shut it down the wreck occurred, indicated in the photos. Investigation showed that the alternator's bearings were completely destroyed by overheating. Shaft journals in these bearings showed signs of overheating. Condition of these parts indicates that both of the alternator's bearings burned out prior to complete failure of the machine.

It also appears likely that the alternator's rotor vibrated violently after the burnout. This caused the generator's end bells to break, as in the left-hand photo, so that for a brief period its rotor was supported at one end by a turbine bearing and at the other by a reduction-gear bearing.

When vibration reached a critical point, the heated generator shaft bent and then broke. At about the same instant the turbine shaft snapped, the flexible coupling between turbine and generator pulled apart, bearing pedestals were torn from their bases and



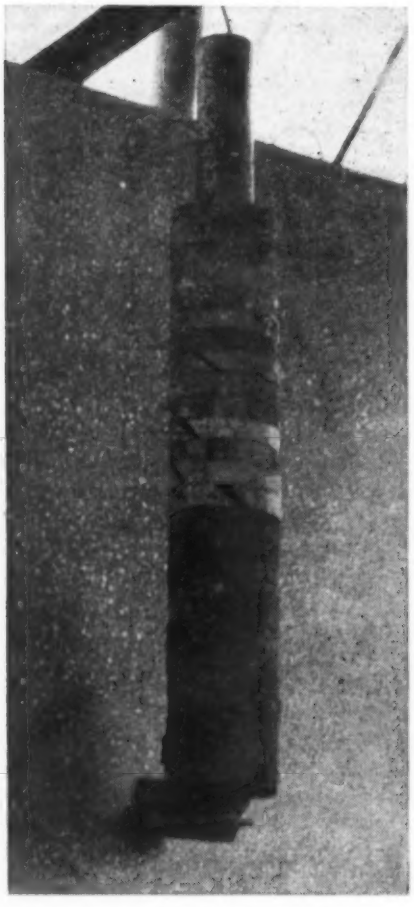


the turbine casing broke, as in right-hand photo. Generator stator was damaged by dropping of the rotor, and the windings were burned out by electrical short circuits.

It is clear that faulty lubrication caused the accident, but the reason for lack of oil in the generator bearings has not been determined. However, the photos indicate how serious a lubrication failure may be. This one caused about $15,000 damage.

Holder Keeps Ring Packing in Condition

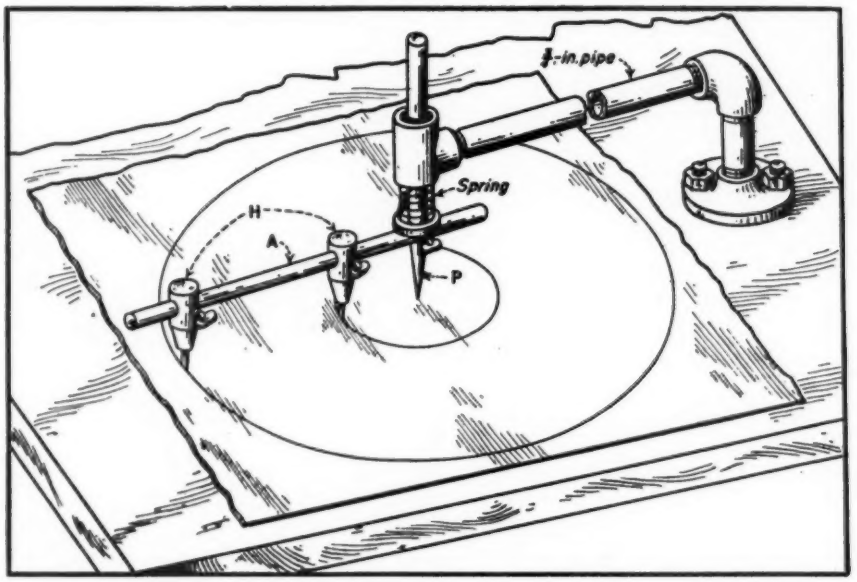
AN ENGINEER in charge of portable machines like pumps found it difficult to keep ring packing in good condition. He solved this problem with a pipe nipple of about the same outside diameter as the hole through the packing rings. A large washer is welded to one end of the pipe to serve as a retainer for the



packing rings when they are placed around the pipe, as in the photo.

A heavy wire placed inside the pipe terminates in a hook, which is placed over a peg or shelf edge in the tool box to keep the packing clear of other equipment. When packing a pump rod this wire serves to support the holder for easy access. To remove a split ring of packing it is lifted above the pipe and the wire slipped through its parting.

Houston, Texas CHARLES C LINDE



CUTTER SIMPLIFIES GASKET FORMING

HAMMERING OUT GASKETS on the surface where they are to be used is poor practice because it destroys the gasket's edge. The diagram shows a simple gasket cutter, which we made, mounted directly on one end of the work bench. The swing arm is of ¾-in. pipe and a tee supported in a flange fastened to the bench.

Arm *A* is made of ¼-in. round steel bored at one end for the center pivot *P*. The cutter holders *H* are of ½-in. brass bored to go on arm *A*. Cutters are made from a round file and ground to fit in a hole in the holder's ends. We poured babbitt around the pivot extension in the ¾-in. tee and then worked the extension until it moved freely. A spiral spring on the pivot extension, between the tee and arm *A*, forces the pivot and cutters down on the packing. Butterfly set screws in the cutter holders permit easy adjustment for cutting gaskets of the desired size.

Flushing, N. Y. S M ELONKA

Copper Strips on Armature Bands Cause Heating

AFTER AN ARMATURE for a dc motor was wound and installed the banding wire became very hot. It was evident that eddy currents were being induced in the bands so we removed the armature to locate the cause. The armature had three bands on the core and a band on the coils outside the core at each end.

The coils outside the core made a slight slope down from where they came out of the slots. To insure that the bands would not slip off the coils the armature winder, at six places around the core, had placed a thin copper strip parallel to the coils under the bands. These he soldered to the bands to hold the latter together.

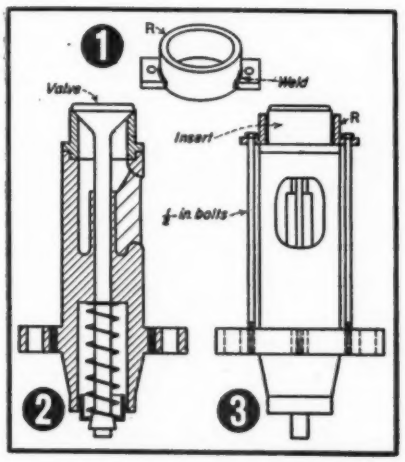
This arrangement was equivalent to a squirrel-cage winding on the rotor of an induction motor. The copper strips acted as the bars in such a winding and the bands as the end rings. The copper strips had a voltage induced in them just the same as the armature coils, and being short-circuited by the bands sufficient current flowed in them to cause serious heating.

To correct this condition we removed the bands and copper strips and then put on three new steel-wire bands insulated from the core. Over the coil ends outside the core we put on seine-twine bands. To keep these bands in place when running them on, we first put on a layer of friction tape. Saturating these bands with insulating varnish after they were in place securely fixed them on the winding.

If it is necessary to use copper strip

ties between bands, they must be so placed that equal voltages of the same polarity will be generated in them. This is done by placing the ties exactly two pole spaces apart and limiting the number of ties on a 4-pole machine to two, 180 deg apart; three on a 6-pole machine, 120 deg apart; four on an 8-pole machine, 90 deg apart, and so on. When so placed voltages generated in the tie strips are equal and in the same direction at all times, therefore current cannot flow in them to cause heating. However, it is best practice not to use the tie strips unless there is no other safe way of doing the job.

Philadelphia, Pa. R O SPENCER



Clamp Holds Valve Seat for Grinding

FIG. 2 SHOWS a cross-section through one of our engine valves and valve cages. Valve seats, of stainless steel, are inserted into the cages. When the valve cage is bolted in place, the stainless-steel insert seats in the cylinder head and is held securely. When the cage is out of the engine and the valve removed from it the insert may be loose. To lock the inserts in their cages when reseating and grinding in the valves we made a clamp shown in Fig. 1.

We cut from a piece of 4-in. pipe the ring *R* that goes around the valve-seat insert. Its outside diameter is only 3¾ in. so we cut a small section out of the pipe ring, drew the two ends together and welded them. On each side of the ring we welded a lug with a hole through it for a holding-down bolt, Fig. 3.

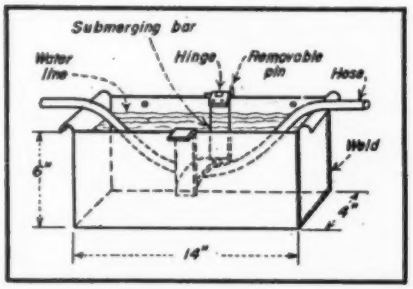
The valve-cage flanges have 1-in. clearance holes for the holding-down bolts and ½-in. threaded holes for jack bolts to lift the cage if it is stuck. To lock the valve-seat insert in position we place the ring, Fig. 1, around it. Then, with ½-in. bolts threaded into the tapped holes in the cage flange we tighten the ring onto the insert as in Fig. 3.

The clamp holds the insert firmly for reseating with high-speed stones and for grinding in the valves in the same position they had when assembled in the engine head. For only a small amount of grinding we use the palm of the hand to turn the valve on its seat. If considerable grinding is required we use a breast drill. Holding it and putting pressure on the valve with one hand, we work the drill handle in short movements with the other hand until the valve has been correctly seated.

Shiprock, N. M. JAMES F MAHER

Portable Tank Tests Welding Hose Lines

TEST OXYGEN AND ACETYLENE welding hose lines regularly, and repair any leaks immediately, following recommendations of The Linde Air Products Co. The diagram shows a simple way of making the tests in a water tank,



made of light-gage sheet metal welded to make joints waterproof. Dimensions shown are 14 in. long, 4 in. wide and 6 in. deep. Sides and bottom can be made of one 14x16-in. piece and the ends of two separate pieces 4x8 in.

Make two right-angle bends in the large piece, parallel to the 14-in. dimension and 6-in. from each end, to form the two sides and bottom of the tank. Bend one end of each end piece to form a curve on which the hose rests. Start this bend 2 in. from the end of the piece and make it over a 1-in. pipe held in a vise. Weld the ends to the sides and bottom to complete the tank. The curved ends serve as smooth surfaces over which to slide the hose, and also form convenient handles.

Make a submergence bar from ¼x1½-in. strap iron, bent to the shape shown in the drawing, so that it extends down in the tank 4 in. Bend one end so that it rests on one of the tank's sides. Weld the other end of the bar to half of a hinge from which the pin has been removed. Weld the other half of the hinge to the tank side so that the submergence bar can be held in it by a removable pin, as shown. Drill two holes in the back of the tank so that it can be hung conveniently on a wall for stationary use. Fill the tank with water to about 1 in. from its top. Place the hose line over the tank, then put the submergence bar in place and lock it with the removable pin. Pull the hose when under pressure through the water up to within a few inches of the regulating gages. Leaks in the hose are indicated by bubbles, the same as from the inner tube of an automobile tire. The remaining few inches of the hose can be tested in soapy water when the regulator connections are tested.

Anaconda, Mont. EARL W KINNEY
Anaconda Refining Co

Gasket Lacing Makes Flexible Coupling

THE LEATHER DISK wore out and had to be replaced about every six months in an 8-pin flexible coupling between a motor and a pump. When the last disk failed leather was not available to make a new one. In the emergency our maintenance engineer removed the

pins and laced the two coupling halves together with sealing gasket used in cold-storage doors.

This material has already lasted twice as long as the leather disks. Whereas the disk and pin arrangement started to rattle after 30 days' service the lacing eliminated this and the vibration that caused it. Service with the lacing has been so satisfactory that we did not install the new leather disk when it arrived and probably will not.

Marissa, Ill. GEORGE HOLMAN

READER'S PROBLEMS

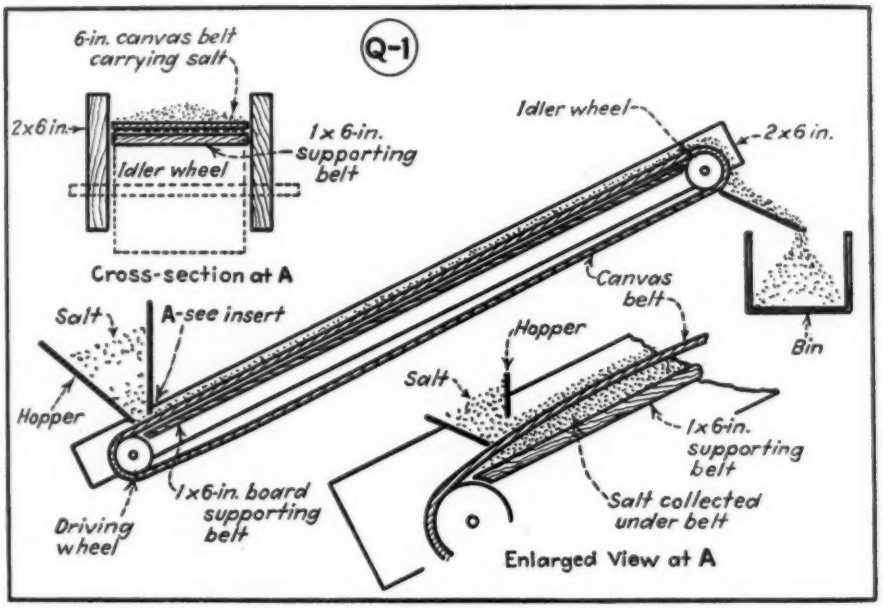
Exercise your engineering wits by submitting answers to these questions fresh from the plant. Suitable material will be paid for; answers accompanied by sketches or photographs command additional pay

1—How Shall I Prepare Load-Distribution Chart?

OUR CENTRAL-HEATING PLANT consists of two hrt boilers. Each has 1150 sq ft of heating surface. One is fired with a stoker and the other by hand with coal and wood refuse from a planing mill. The plant operates from 4:00 am until 10:00 pm with output ranging from 3000 to 6500 lb per hr of steam and peaks somewhat higher. Pressure is from 100 to 125 psi. A pyrometer is installed with thermocouples in each breeching takeoff above the individual dampers. No equipment is available for checking each boiler output but I believe some economy will be effected by balancing the two units on heavy loads.

I have in mind preparing a chart, for each boiler in the operating pressure range, of flue-gas temperatures that correspond to the various loads. Opposite these values would be indicated the type of performance such as good, fair or poor. The different performance rating would include several temperatures. This chart should make it easy for the fireman to determine when to shift the load between the two boilers and how to vary it to get the best economy out of the heating plant.

If POWER readers have ever used such a chart will they give me some idea how to construct one, showing sample layout? If data are required other than pressure and flue-gas temperatures what apparatus would be necessary and how should it be arranged to get the information—*LGS*



2—How Can I Prevent Conveyor Spilling Salt?

IN OUR WATER-TREATING PLANT I constructed a belt conveyor to carry rock salt from the warehouse to the storage bin at the dissolving tank. The conveyor, sketch Q-1, works fairly satisfactorily but salt that spills over the sides of the belt piles up under it, as shown in the insert. As this pile increases more salt is spilled, and soon is piled up so high it jams the belt and causes it to slip. I have to remove it completely every ten to 15 days and clean the conveyor. This excess maintenance is a lot of trouble and nullifies the time-saving feature of the conveyor. A wide belt would solve the problem but I would like to make the machine work without rebuilding it. How can I do this?—*BDL*

Answers to December Questions

How Can This Oil Heater Be Corrected?

(This is Question 1 from the December issue, with best answers from readers.)

IN OUR OIL-PURIFICATION SYSTEM *the oil is preheated with an electrical heater before it enters the centrifuge. The heater has ample capacity to heat the volume of oil to the required temperature. We are allowed a 40-F temperature variation from 140 to 180 F at the centrifuge. Our thermostat can be adjusted to a 20-F minimum variation, and we have been operating it at 130 to 150 F.*

There is a time lag or defect in the heating system that sets up a periodic flow of hot or cold oil. By observation we have noted that the oil temperature reaches a maximum of 195 and drops to 100 F although the thermostat cuts in and out at set temperatures.

When slugs of cold oil reach the centrifuge they slow up the process and cause the constant flow of oil to spill over the intake. We have been advised that if minimum oil temperature is not maintained dirty oil will carry over into the clean oil and thus contaminate it.

How can we arrange our heating system, shown in sketch Q-1, to get uniform oil temperature?—MCC

Add Two Thermostats and Power Contactors

CLOSE CONTROL of *MCC*'s electrical heaters is needed to maintain constant temperature. I suggest he add two more thermostat control switches and power contactors. Wire them as in sketch 1-A for three different circuits. Control switches should be adjustable over the operating range and set as follows: Thermostat

No. 1 closes its circuit at 140 F and opens at 180; No. 2 closes its circuit at 135 F and opens at 170; No. 3 closes at 130 F and opens at 160.

Thus each thermostat controls two heaters. This arrangement should keep oil temperatures well within the limits of 140 to 180 F required by *MCC*'s oil-purification system.

Brooklyn, N. Y. A J WENIG

Install Baffles for Uniform Flow of Oil

TWO BAFFLES, sketch 1-B, will help solve *MCC*'s problem because the relatively large slow-moving mass of oil in the chamber changes its flow pattern as it is heated. Oil first goes through the chamber in the most direct route from inlet to outlet. As it is heated in the chamber, the oil becomes lighter and less viscous; therefore cold oil entering the chamber spreads out over the bottom. This oil forms two distinct layers. When the thermostat cuts off the heaters the flow again starts from inlet direct to outlet and the cycle repeats.

If this does not give the required temperature control, separate the heaters to avoid the on-off method now used. If the inlet oil always requires heating, No. 1 heater could be separately connected and left on while oil is fed to the heater. A more complicated method would be to have No. 1 heater controlled independently by a thermostat on the inlet oil.

If installing baffles is impracticable, reconnect No. 1 heater so it will operate continuously. This should bring the exit oil temperature variation within the required limits.

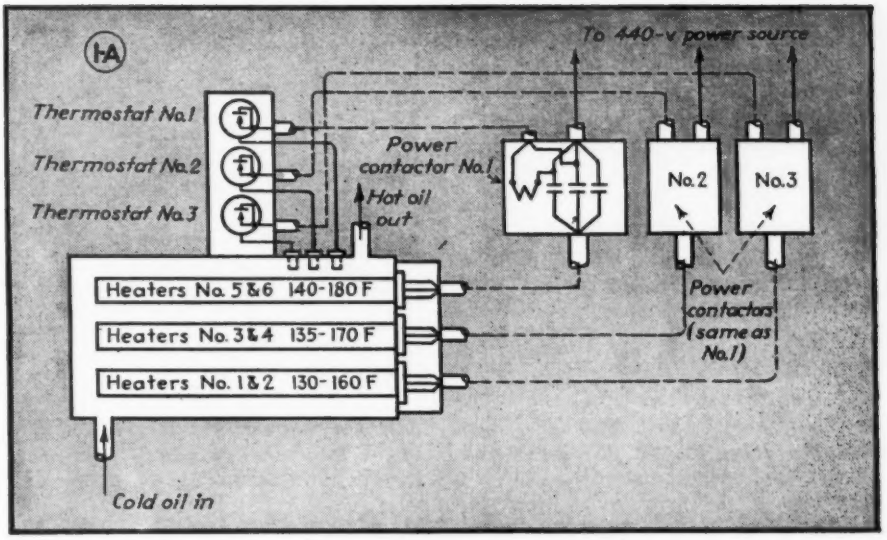
Glenview, Ill. R H MCKANE

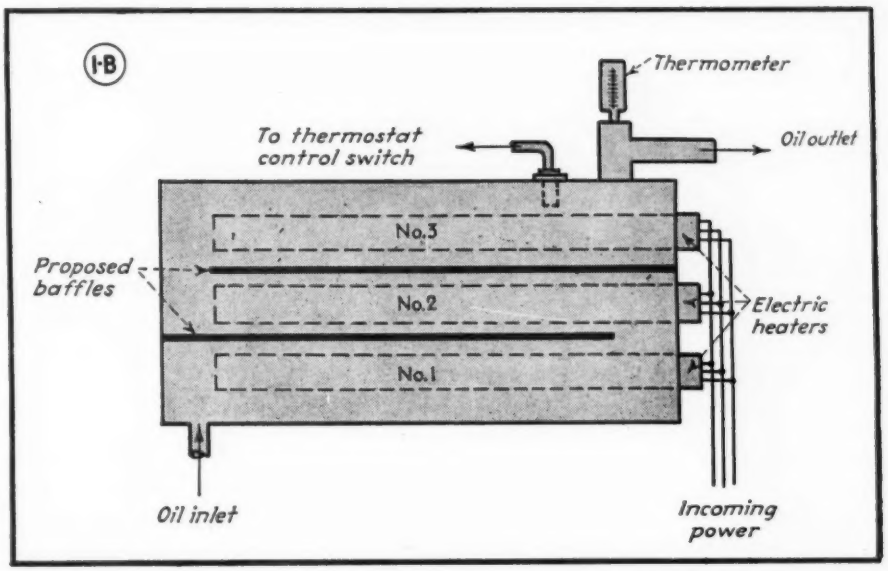
Restrict Oil Flow To a Smaller Area

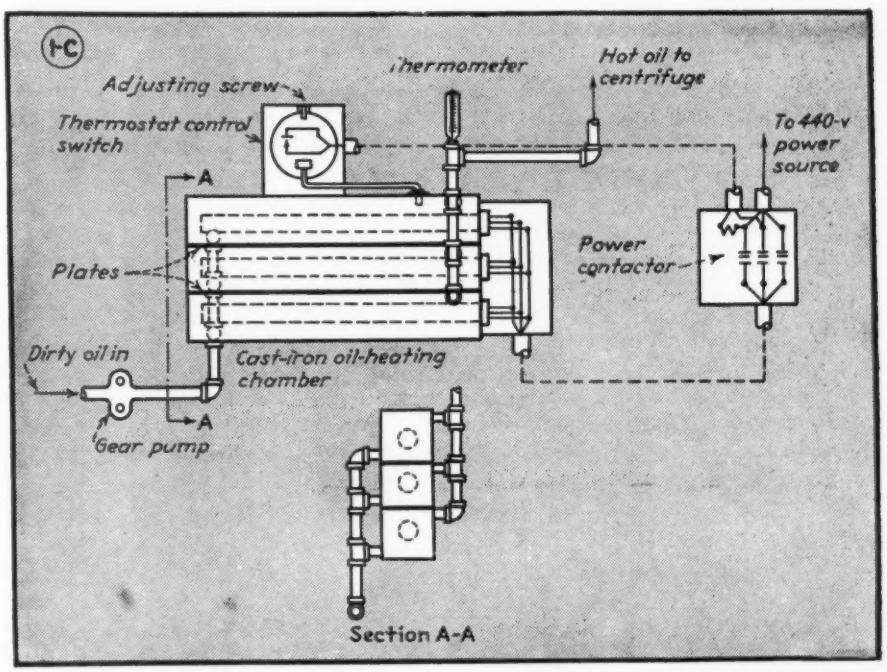
THE TROUBLE with *MCC*'s oil heater seems to be caused by an irregular path of oil flowing through the heater. When the oil takes a short path, temperature drops. Conversely, when it takes a long path temperature rises. This results in an inefficient heat transfer to the oil.

If plates are inserted between the heating elements, sketch 1-C, oil flow is restricted to a smaller cross-sectioned area. The piping arrangement shown will execute a more uniform oil flow. If at any time the temperature is rising in one compartment ,the oil from the other two compartments will equalize the outlet temperature since it is very unlikely that the flow in the three compartments will be the same.

West New York, N. J. A DI LORENZO







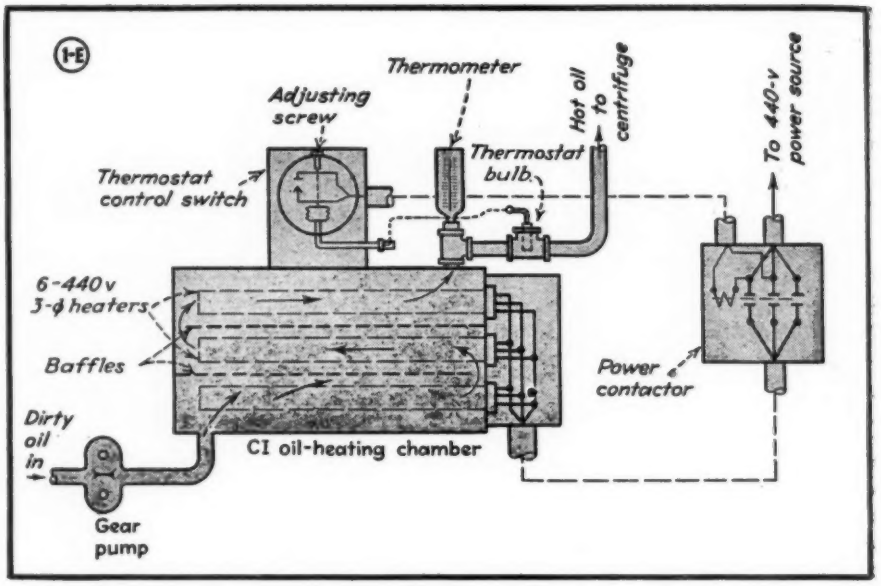
Move Thermostat Bulb to Heater Discharge Line

THERE ARE TWO REASONS for excessive temperature fluctuation in *MCC*'s heater: (1) Thermostat bulb is not in the path of the oil flow. (2) Oil is not properly directed over the heaters.

As a result the thermostat may operate perfectly but still fail to give the desired temperature at the proper point. Because it is away from the direct line of oil flow the bulb remains within the cutout temperature limits for an excessive time thus allowing the heaters to rise above the proper point and similarly to cool far below cut-in temperature. This can be remedied by installing the bulb of the thermostat directly in the line of flow, sketch 1-E.

At present oil follows the path of least resistance, which is directly from inlet to outlet. Much better heat distribution is obtained by installing two baffle plates between the heating elements, also shown in sketch 1-E. This would eliminate hot spots and assure more uniform temperature.

Seattle, Wash. H E BENNETT



Recirculate the Hot Oil Through Heater

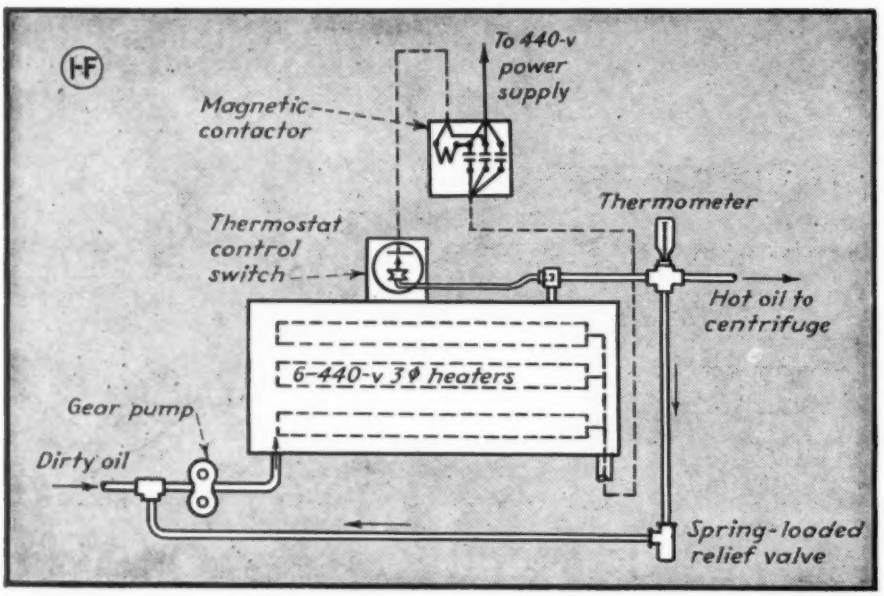
IN *MCC*'s OIL HEATER it would seem that the heating units have too great a capacity. When the thermostat opens the circuit, the heaters continue to heat the oil and when the circuit is closed, the heaters do not get hot soon enough to have the desired effect. It is possible that the units are coated with carbon or sludge.

If they are clean and suitable for the job I offer these suggestions. If the gear pump is provided with a relief valve, either self-contained or connected in the discharge of the pump, the flow circuit, sketch 1-F, will give better circulation and more efficient heating. By putting the relief valve on the far side of the heater from the pump more oil is forced through the heater and some hot oil is recirculated. Thus the temperature rise is less and should be easier to control. Thermostat bulb should be mounted in the outlet from the heaters because this is the temperature that needs regulating.

Variation of 20 F in a thermostat is rather large, but the rearrangement shown should give better results. In my experience best results are obtained by keeping the heater sheath temperature low and the fuel moving fast to prevent carbon forming on the heater elements.

In this hookup there should be no valves between the pump and relief valve, so that the heater will be protected if it is turned on before the oil flow starts.

Rushville, Ind. G D NOILES



Minimum Oil Temperature Through Separate Switch

DIFFICULTY with *MCC*'s electrical heater is that all heater elements are energized from one contactor, which is controlled by the thermostat. From the thermostat's location (sketch Dec 1945) the heater elements cannot maintain constant temperature. When the thermostat cuts the power off, the heaters cool. Before the oil temperature drops enough to cause the thermostat to reclose the circuit there is a large body of cold oil in the heater that has no chance of being heated before it passes out of the chamber.

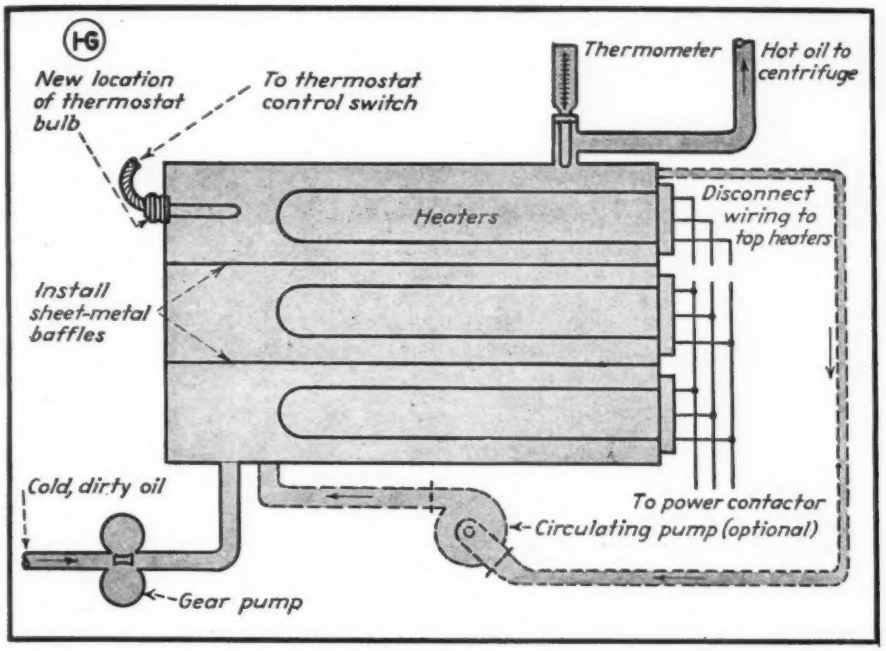
A separate switch is needed to control enough of the heaters to maintain minimum temperature. *MCC* should determine number of elements for this purpose by experiment. This separate switch can be operated manually or by a pressure switch in the pump discharge line so that power is cut off when the pump stops. The thermostat would then cut in and out and keep the oil within the allowable range.

A pilot light in each circuit is helpful to indicate when the heaters are on.

Dorchester, Mass. W F O'REGAN

Provide Hot-Oil Capacity Above Heaters

I BELIEVE *MCC*'s oil heater has greater heat input than is required. He should disconnect the top heating element. There is not enough reserve oil capacity



to supply the centrifuge while heat is off, or to absorb high-temperature oil while it is on. He should move the thermostat bulb to new position, sketch 1-G, to give a more even temperature in the heater. Baffles prevent heated oil rising to the top too quickly. They also make a reservoir at the top where heating element has been disconnected or removed. If requirements justify the expense, it would be well to install a circulating pump, dotted in sketch 1-G. He should make an effort to obtain a thermostat with less temperature spread.

Bellingham, Wash. D H BERGMAN

(*Continued on page* 142)

What Causes This Motor to Slow Down?

(This is Question 2 from the December issue, with best answers from readers.)

A WOUND-ROTOR INDUCTION MOTOR, *75 hp, 440 v, 3 phase, operates a skip hoist, which has just been installed in a 500-ft. mine shaft. The hoist man is an experienced operator who has recently been transferred to this hoist. Shortly after taking his new job the operator asked me to repair the controller, which is a hand-operated drum type. His complaint was that sometimes when he shifted into the last notch the hoist would slow down instead of speeding up as it usually did. This last position completely short circuits the rotor circuit resistance; therefore I felt sure that loose or dirty contacts caused the trouble. I cleaned and checked the fingers and contacts in the controller. This cleaning, however, did not correct the trouble and since that time I have gone over the entire electrical system.*

So far all efforts have failed to find the cause of this slowdown in the last position. I have noticed, however, that when the hoist slows down in the last position it speeds up again if the controller is moved to next to last position.

Can POWER *readers give me some clue as to whether the trouble is in the motor or caused by some defect other than wiring?—TSD*

Wiring Is Trouble Source

THE REASON TSD's slipring motor slows down when the controller is moved to the last notch is that the connections are wrong between the controller and resistance grids. In some way the connections have been made so there is a lower resistance in the secondary circuit in the next to the last notch. When the controller is set on the last point there is still some resistance in the circuit. Amount of this resistance is more than in the next lower step so the motor actually picks up speed when the controller is dropped back a notch. In sketch 2-A, points 11, 12 and 13, represent the last notch where the secondary resistance is short circuited. When hooking up the controller and the resistors, some resistance has been left in this circuit. Probably one of these wires is hooked back on a lower number in such a way that it produces the action described. The only way to correct it is to take the manufacturer's print and check every circuit point by point. If the controller and the resistors are some distance apart and the wires are not marked, it will be a mean job. The results will be well worth the trouble, however.

Carlsbad, N. M. E A ROBERTS

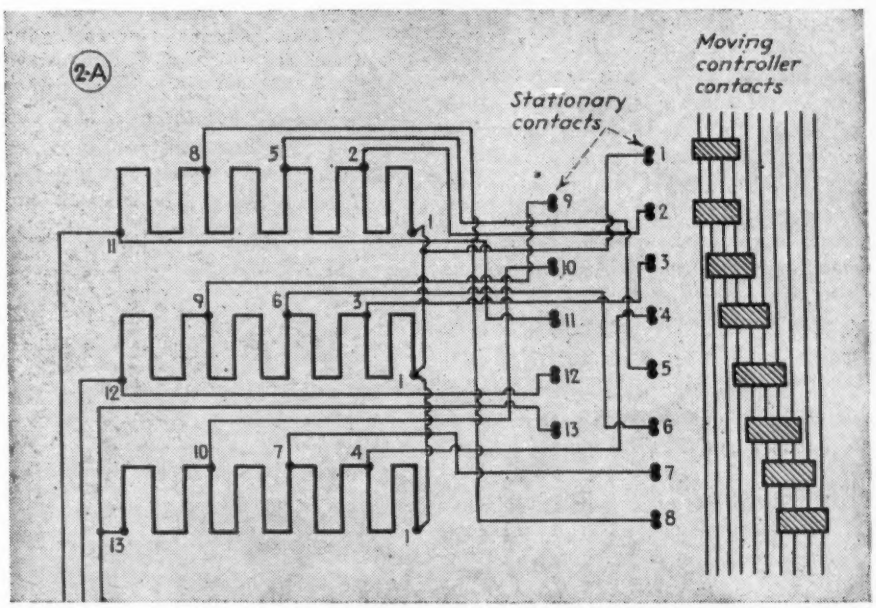
Check Wiring From Sketch

TSD CLAIMS THE MOTOR slows down when the drum controller is turned all the way on. In this position drum controller should cut out the rotor circuit resistance and the motor should run the same as a squirrel-cage induction motor.

If the motor slows down with the controller fully on, it indicates an opening in the rotor circuit. Sketch 2-B shows the complete circuit (see page 144).

To test the rotor circuit remove the brushes from brush holders and with a

(*Continued on page* 144)



CENTRIFUGAL PUMP Q AND A FOR POWER ENGINEERS

By I J Karassik and Roy Carter

12—Pumps in Parallel and in Series; Drivers

Twelfth in a monthly series by Igor J Karassik and Roy Carter, Worthington application engineers. These two experts on centrifugal pumps have selected questions and answers that give a broad, practical understanding of the pumps, their construction, operation, characteristics, troubles and remedies.

Q 1—When are two or more pumps used in parallel?

A—Demand in pumping installations varies over a wide range. If a pump were large enough for the maximum flow, it would be inefficient at reduced capacities and would develop excess head. Also, where high reliability is required, as in a waterworks, there would have to be a duplicate unit of the same size as a spare.

For such installations it is best to have two or more smaller pumps so that capacity can be adjusted to demand. Sometimes units have equal capacity, while at others they are of different sizes. Waterworks and similar services have a sufficient number of units so that one or more of them are in reserve.

Even when constant capacity is needed, two or more pumps operating in parallel are often desirable or necessary. Some installations are so large that a unit to handle full capacity is not feasible. Other setups use units of ½, ⅓, ¼ or smaller capacity with one or more spares that have lower installed cost than for two full-sized units. Still other plants use two or more pumps in parallel so that the most efficient driver speed of existing drivers can be utilized.

Q 2—Must two pumps be identical before they can operate in parallel?

A—Satisfactory operation of pumps in parallel depends as much upon the system-head curve on which they are to operate as on the pumps themselves. If the system head permits, pumps can have dissimilar characteristics. The same combination might not be satisfactory for other system characteristics. When pumps operate in parallel on a system where flow is regulated by throttling (most boiler-feedwater systems are of this type) they should have a similar and stable characteristic with practically the same shutoff head. For such applications, units may safely have unequal capacities provided the shutoff heads and general shape of the head-capacity curves are similar.

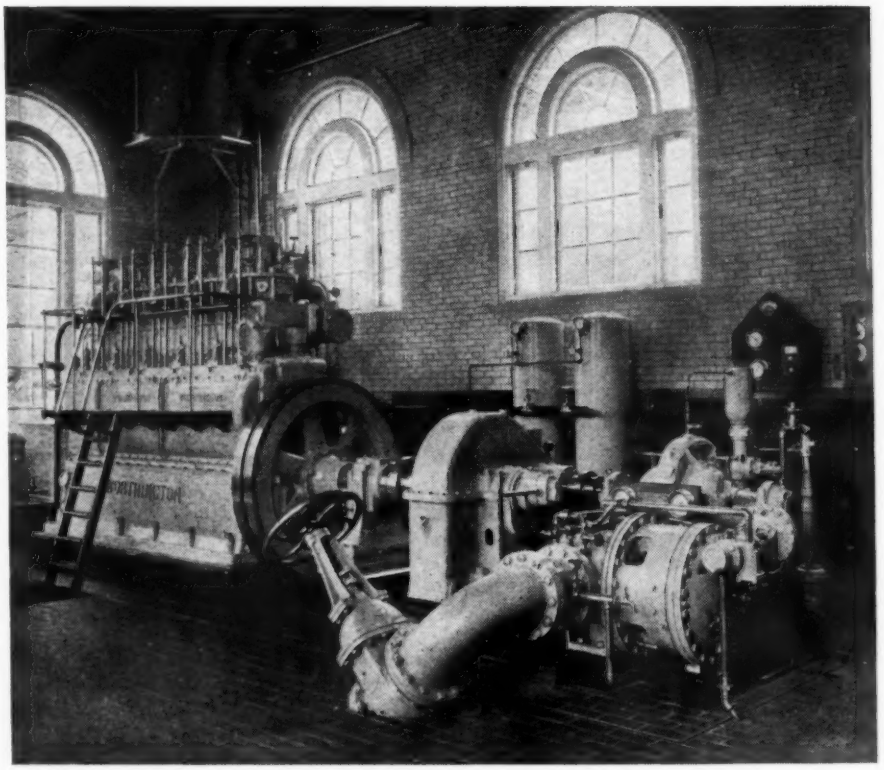


Fig. 1—Through a speed-increasing inclosed gear unit, a low-speed heavy-duty diesel engine drives a centrifugal pump at the proper speed for the service conditions

Q 3—When are two or more pumps used in series?

A—When the total head of an installation exceeds that which can be developed in commercially available single-stage pumps, multistage pumps are normally used. Multistage pumps are only commercially available in the smaller sizes with some coverage in intermediate sizes and with practically none for pumps of over 12-in. discharge size. Practically the same results accomplished with a 2- or 3-stage pump are obtained by connecting two or three single-stage pumps in series by external piping, Fig. 3, instead of integral water passageways generally used in multistage pumps.

Series units are most generally applied for heads 250 to 500 ft and are generally two single-stage double-suction pumps in series. Generally, series units are arranged to be powered by a common driver but separate drivers for each stage can be used. Sometimes waterworks use two pumps in series for small capacities rather than a multistage pump, thus often

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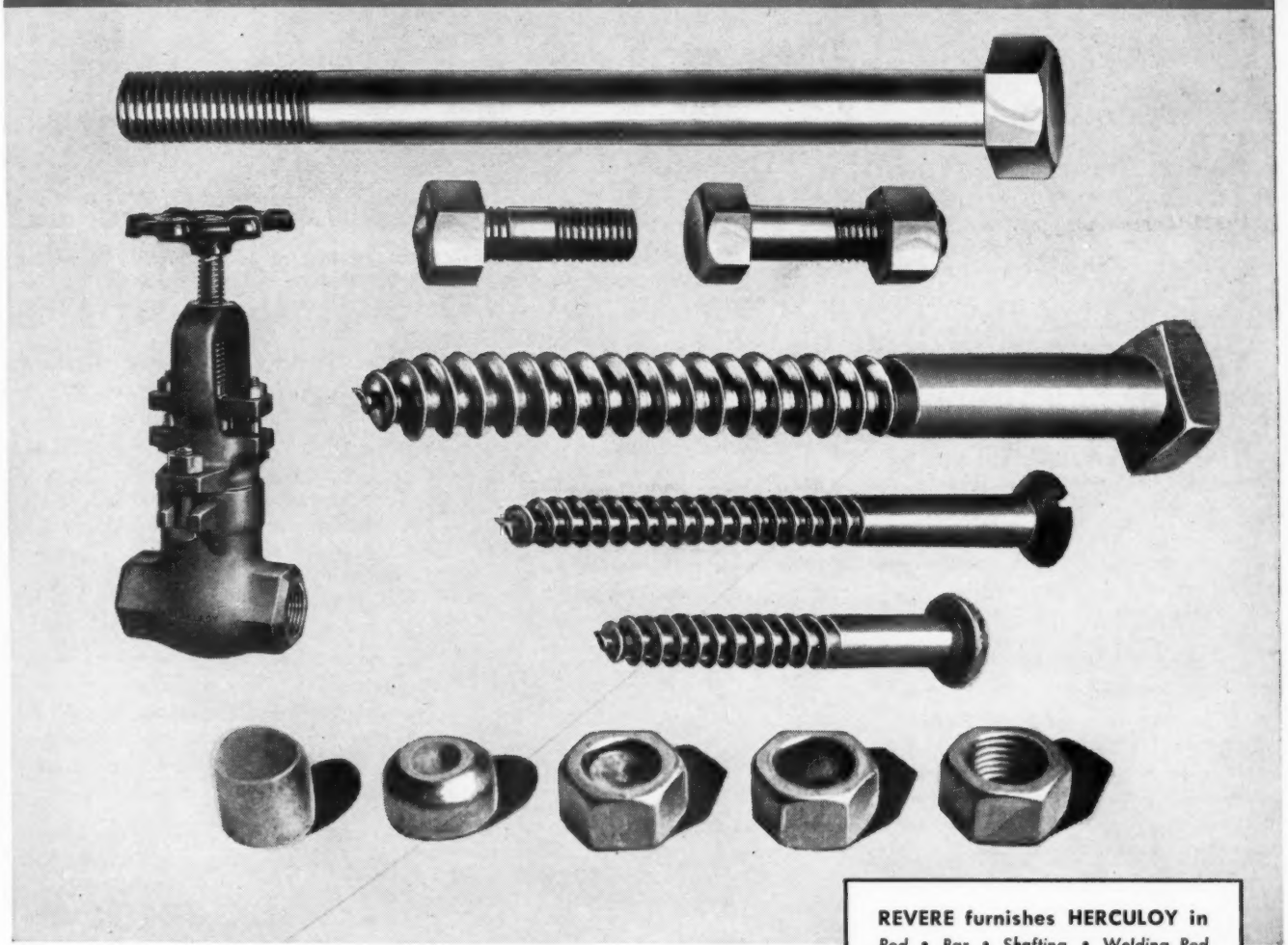

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obtaining a better pumping efficiency.

Q 4—Must two pumps be identical before they can operate in series?

A—Characteristics of pumps in series do not have to be similar for satisfactory operation because the head developed by one pump adds to that of the other. For an efficient unit, capacities at best efficiency for the individual pumps should be about the same. If one pump has a larger capacity than the other, it should preferably be used for the first stage.

Q 5—Why are pumps comprising a series unit usually identical?

A—While other combinations are possible, most series pumping installations consist of two identical single-stage double-suction pumps. With identical pumps: (1) Most or all parts of the individual pumps are interchangeable and a smaller number of spare parts are necessary to guard against outages. (2) Unit cost is generally, but not always, the lowest. (3) A common driver can be used, which permits selection of the best operating speed and obtains highest over-all efficiency.

Q 6—What is the normal arrangement of pumps operating in series with a single driver?

A—One arrangement commonly employed with small units has a double-extended-shaft motor between the two pumps in series, Fig. 3. For larger units and, when necessary, for small units, single-end drivers are used and one pump is built with a double-extended shaft. Then, the shaft of the pump next to the driver must transmit the total horsepower required by the unit. This arrangement is used with steam turbines and most internal-combustion engines because they are not suitable for double-shaft-extension drive applications.

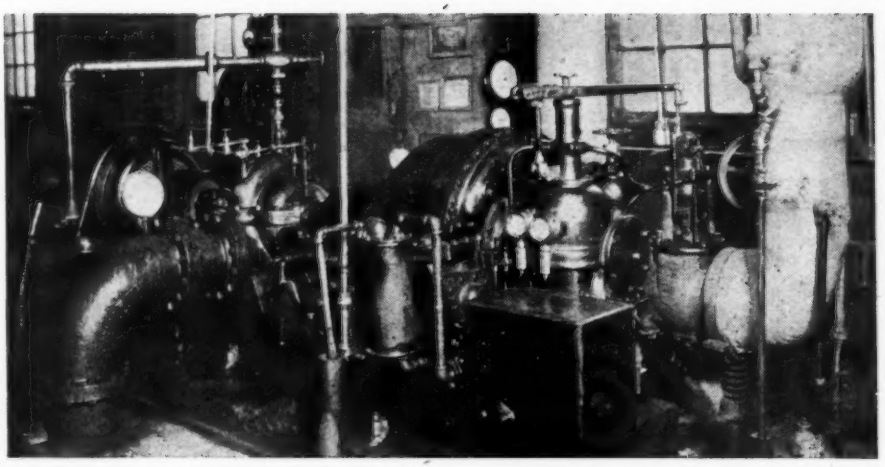

Fig. 2—A 250-hp dual drive, consisting of a steam turbine on the right and a squirrel-cage induction motor on the left, powers the centrifugal between the two

Q 7—What is a tandem-driven pumping unit?

A—In some industries two or more pumps are necessary for different steps in a process. If the service conditions permit the same rotative speed and if the pumps can be placed together, it is often advantageous to use a common driver on one end. Such units are called tandem driven. Strictly speaking two pumps in series, with the driver at one end, form a tandem-driven unit.

Q 8—What prime movers can be used to drive centrifugal pumps?

A—Probably every form of prime mover and source of power has been used, with some form of intermediate transmission, if necessary, for centrifugal pump drives. Most centrifugal pumps, however, are electric-motor driven. Steam turbines, gasoline engines, diesel engines, gas engines and water turbines are also used. Steam engines are now rarely used.

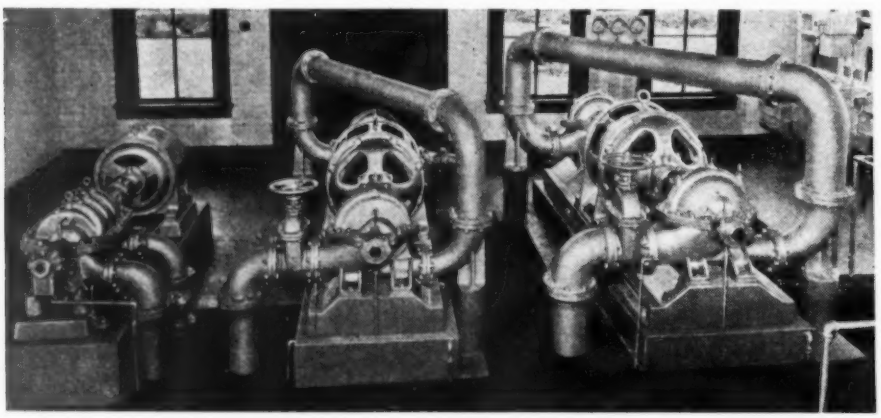

Fig. 3—Two series pumping units, each consisting of two single-stage double-suction centrifugal pumps in series and driven by an electric motor between them

Q 9—What factors influence selection of driver size for a centrifugal pump?

A—A number of local conditions affect permissible loading of various drivers. Safe loading of an electric motor depends on its design as well as on temperature and density of the surrounding air and variations in line voltage. Other types of drivers are also affected by local conditions. The driver should be capable of driving the pump over its entire operating range under the most adverse conditions. Where the driver is suitable for variable-speed operation and a decrease in head is acceptable, the pump is sometimes operated at reduced speed to keep maximum power within the driver's rating.

Q 10—When selecting a motor for driving a centrifugal pump, should a normal- or high-starting torque type be used?

A—Normal-starting-torque motors develop more than sufficient torque for starting centrifugal pumps even with the discharge valve open. All centrifugal pumps require low torques to start. The torque required to start from rest generally does not exceed 15 to 20% of normal operating value. It is generally highest in a sleeve-bearing pump if it has been idle for some time, causing the packing to stick to the shaft sleeves and the oil to be squeezed out from between shaft and bearings.

Q 11—Will operation of a centrifugal pump at heads other than its design value overload the driver?

A—Power required to drive a centrifugal pump from shutoff to maximum capacity varies with its specific speed and its individual design. For the lower specific-speed types, power requirement is minimum at shutoff, and maximum at or near maximum capacity. Operation of

(*Continued on page* 138)

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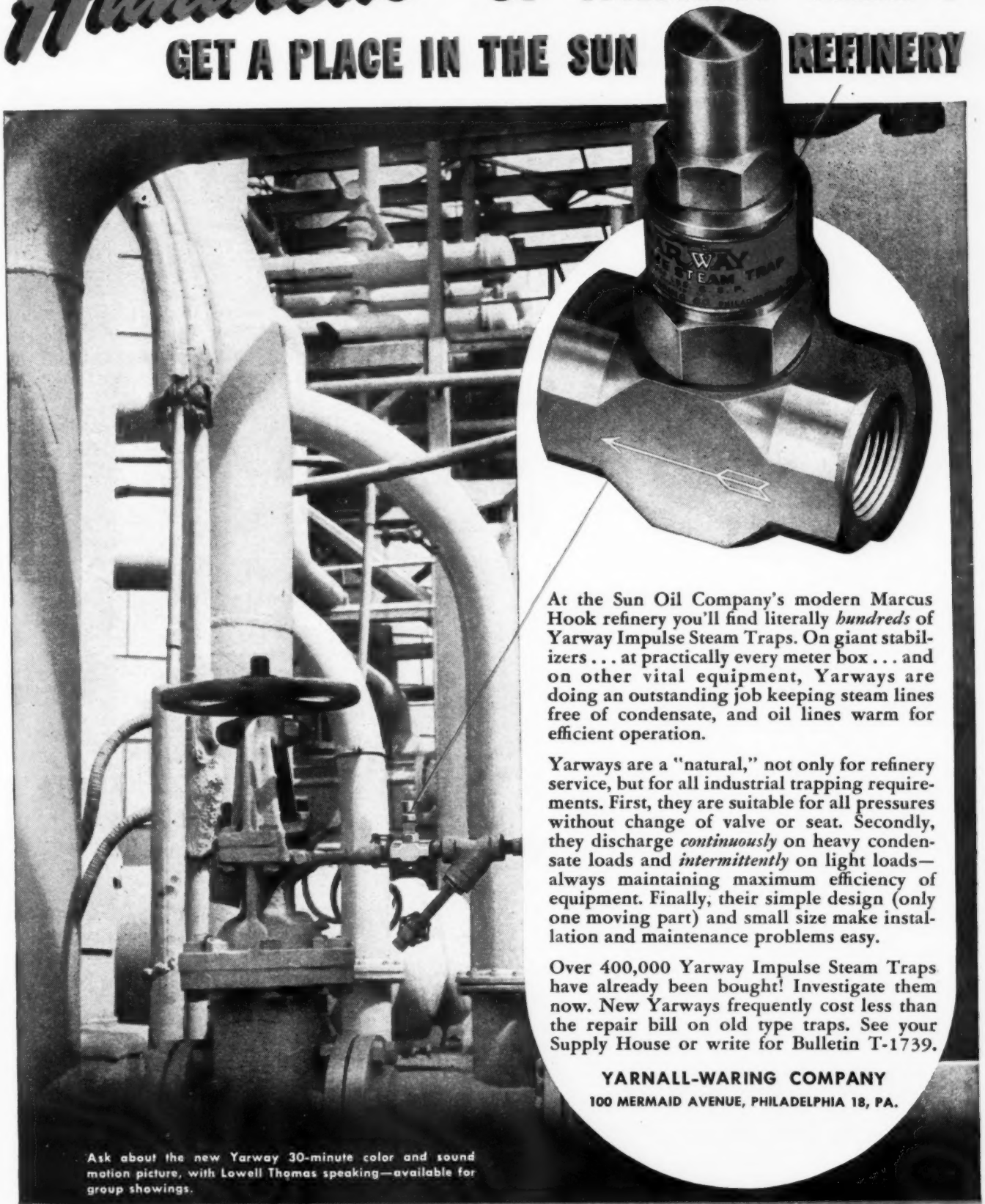

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MATH TIPS

PHIL SWAIN GIVES HELPFUL HINTS TO EVERYDAY USERS OF NUMBERS AND HOMESPUN MATHEMATICS

9—Shortcuts in Arithmetic

▶HERE ARE some convenient shortcuts in arithmetic—all exact. Shortcut approximations will be shown next month.

To multiply a number by 9, multiply by 10, then subtract the original number.
Example: 2783 × 9 = ?

27,830
2,783
25,047 *answer*

Rule: Where two numbers to be multiplied are respectively above and below the same multiple of 10 by the same amount, their product equals the square of this multiple of 10 minus the square of the difference between either number and the multiple of 10.

Example: 998 × 1002 = ?

Here the multiple of 10 is 1000, the difference is 2 and the square of the difference is 4. Then:

1000 × 1000 = 1,000,000
1,000,000 − 4 = 999,996 *answer*

Example: 97 × 103 = .?

Here the multiple of 10 is 100, the difference 3, and its square 9. Then:

100 × 100 = 10,000
10,000 − 9 = 9991 *answer*

Example: 880 × 1120 = ?

Multiple of 10 is 1000
1000 × 1000 = 1,000,000
120 × 120 = 14,400
1,000,000 − 14,400 = 985,600 *answer*

Example: 53 × 47 = ?

Multiple of 10 is 50
50 × 50 = 2500
3 × 3 = 9
2500 − 9 = 2491 *answer*

Other examples:

23 × 17 = ?
20 × 20 = 400; 400 − 9 = 391 *answer*
24 × 16 = ?
20 × 20 = 400; 400 − 16 = 384 *answer*

Rule: Where a number is multiplied by a 2-digit number it may happen that dividing the 2-digit number by 2 or by 3 will change it to a one-digit number. In that case it may be convenient to divide the 2-digit number by 2 or 3 and multiply the other number by the same factor.

Example: 37 × 18 = ?

Here half of 18 is 9. So we can say:

37 × 18 = 74 × 9 = 666 *answer*

Example:

25 × 27 = 75 × 9 = 675 *answer*

Here is a variation of the same idea:

49 × 22 = 98 × 11 = 980 + 98 = 1078

Many other variations are possible.

Rule: You can divide one of the numbers by any factor if the other number is then multiplied by the same factor.

Ingenious computers will find many opportunities to apply this idea.

Example: 3⅓ × 42 = ?

Apply a factor of 3:
10 × 14 = 140 *answer*

Example: 24 × 16⅔ = ?

Apply a factor of 6
4 × 100 = 400 *answer*

Example: 125 × 1616 = ?

Apply a factor of 8
1000 × 202 = 202,000 *answer*

Rule: To add two fractions each having a numerator of 1, add the denominators to get the numerator of the answer. Multiply the denominators to get the denominator of the answer. Thus:

1/2 + 1/3 = 5/6
1/3 + 1/5 = 8/15
1/7 + 1/12 = 19/84

Rule: To subtract a smaller fraction from a larger, where both have numerators of 1, subtract the smaller denominator from the large denominator to get the numerator of the answer. Multiply the denominators to get the denominator of the answer. Thus:

1/3 − 1/7 = 4/21
1/2 − 1/3 = 1/6
1/7 − 1/15 = 8/105

A special case of the foregoing occurs when the denominators of the fractions differ by 1. In that case the foregoing rule comes down to the following:

Rule: The numerator of the answer is 1, and the denominator is the product of the denominators. Thus:

1/2 − 1/3 = 1/6
1/3 − 1/4 = 1/12
1/4 − 1/5 = 1/20

Where one group of digits in a multiplier is a factor of another group of digits in the same multiplier shortcuts may be possible. These are best explained by examples:

Example: 614 × 287 = ?

Here note that 28 is 4 x 7

Then we have:

614
287
4298
17192
176218 *answer*

Since 28 is 4 times 7, the line 17192 is obtained by multiplying 4298 by 4.

Example: 3172 × 2814 = ?

Here the 28 is double the 14, so the problem is worked out like this:

3172
2814
12688
3172
44408
88816
8926008 *answer*

Rule: A mixed number is a whole number plus a fraction. Where each of two mixed numbers to be multiplied is a whole number plus ½, the product is half the sum of the whole numbers plus the product of the whole numbers plus ¼.

Example: 4½ × 6½ = ?

4 + 6 = 10
Half of 10 = 5
4 × 6 = 24
Add ¼ ¼
29¼ *answer*

Example: 15½ × 8½ = ?

15 + 8 = 23
Half of 23 = 11½
15 × 8 = 120
Add ¼ ¼
131¾ *answer*

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REFRIGERATION NOTEBOOK — 27

How the Capacity of Compressors Is Rated

By TERRY MITCHELL, ME, *Frick Company*

▶ COMPRESSOR CAPACITY is measured in tons of refrigeration: One ton equals the cooling effect obtained by melting a ton of ice in 24 hr. When one pound of ice melts it absorbs 144 Btu, and one ton in melting at a steady rate over 24 hr absorbs 144x2000 = 288,000 Btu.

This is cooling at the rate of 12,000 Btu per hr, or 200 per min. Note that the capacity is based both on the amount of heat absorbed and the time; in other words, a ton of refrigeration is not just a quantity, but a *rate* of cooling. Refrigerating machines are always rated on the basis of continuous 24-hr operation, unless otherwise stated. Small low-pressure machines are usually rated in Btu per hr.

Operating temperatures and pressures under which a machine works affect the rate of cooling and capacity. Thus machine capacity varies with the suction and discharge pressures, as well as speed. Capacity also basically depends on size and number of cylinders, valve efficiency, absence of waste clearance space, freedom from wire-drawing and excessive gas friction, and proper cylinder-head cooling.

Suction pressure has such a marked effect on a machine's capacity because of the properties of the gas used as the refrigerant. Cooling work is done by evaporating the refrigerant from a liquid to a gas. Theoretically, a pound of liquid ammonia at O F when boiled into a gas, absorbs about 569 Btu. In practice, the heat in the liquid has to be subtracted, but the addition of superheat to the suction gas may counteract this 10 or 20 Btu.

If the suction pressure is raised to 35 psig, temperature of the boiling ammonia increases to 21.4 F, and the heat theoretically required to change a pound of it to a gas is now only 552 Btu. Neglecting the increased heat in the liquid, and superheat in the gas, the cooling effect per pound is actually less at the higher suction pressure, and the cooling coils are 21.4 F warmer. However, the volume and weight of the gas pumped by the compressor are what count most. Referring to the table, we see that at O F and 185-psig condensing pressure, 3.97 cfm have to be handled to produce one ton of refrigeration. At 21.4 F the volume is 2.46 cfm. The saving at the higher temperature is 61.5% because, as the pressure rises, each cu ft contains more pounds of refrigerant gas.

Hence, when operating at the higher suction pressure the machine has much greater capacity. Compressor volumetric efficiency also increases as suction pressure rises. In practice this all amounts to about 70%, and for the two pressures mentioned, if discharge pressure remains the same. As a rule of thumb, a compressor running at 25-psig suction has twice the capacity of one operating at 5 psig, and three times that at zero gage pressure. Since the horsepower *per ton* required for driving the machine also comes down rapidly, it is doubly worth while to keep the suction pressure as high as possible.

The effect of reducing the condensing pressure is not so marked, as can be seen from the table. In usual practice it adds perhaps 5% more capacity if the head pressure is lowered from 185 to 145 psig. But if the suction pressure is so low that the gas has to be compressed more than six times, head pressure becomes so important that it pays to do the work in two or three stages.

In 1921 the American Society of Refrigerating Engineers adopted certain standard temperatures for specifying refrigerating-machine capacities. These are 5 F for suction and 86 F for discharge. With ammonia these correspond to pressures of about 19.5 and 154.5 psig. The old figure of 185 psig for the head pressure is often used instead of 154.5, as it is more nearly the average encountered in ammonia plants during summer.

CUBIC FEET OF AMMONIA GAS PUMPED PER MINUTE TO PRODUCE ONE TON OF REFRIGERATION

Temp. of gas, deg F	*Suction pressure, p s i g*	*Corresponding condenser pressure, p s i g*										
		105	125	145	154.5	165	175	185	195	205	225	245
−25.7	1	6.95	7.10	7.24	7.29	7.36	7.42	7.49	7.56	7.62	7.74	7.86
−19.2	4	5.88	6.00	6.11	6.16	6.22	6.28	6.33	6.38	6.43	6.53	6.64
−15	6.18	5.32	5.43	5.52	5.56	5.63	5.68	5.72	5.76	5.81	5.90	5.99
−10	9.05	4.68	4.76	4.87	4.91	4.96	5.00	5.04	5.08	5.13	5.21	5.28
− 5	12.22	4.14	4.22	4.30	4.33	4.38	4.42	4.45	4.48	4.52	4.60	4.67
0	15.72	3.68	3.76	3.84	3.86	3.90	3.93	3.97	4.00	4.03	4.09	4.15
5	19.58	3.28	3.34	3.41	3.43	3.47	3.50	3.52	3.55	3.58	3.63	3.69
10	23.81	2.91	2.97	3.02	3.04	3.06	3.10	3.13	3.15	3.17	3.22	3.27
14	27.49	2.68	2.73	2.78	2.80	2.83	2.86	2.88	2.91	2.93	2.97	3.01
19	32.51	2.40	2.45	2.50	2.51	2.54	2.56	2.58	2.60	2.63	2.66	2.70
21.4	35	2.28	2.33	2.38	2.39	2.42	2.44	2.46	2.48	2.50	2.53	2.57
25.8	40	2.08	2.12	2.16	2.17	2.20	2.22	2.24	2.25	2.27	2.31	2.34
30	45	1.91	1.95	1.98	2.00	2.02	2.03	2.05	2.06	2.08	2.11	2.14
33.9	50	1.77	1.80	1.84	1.84	1.87	1.88	1.90	1.91	1.93	1.95	1.98

These are theoretical values. In practice, allowance must be made for losses.

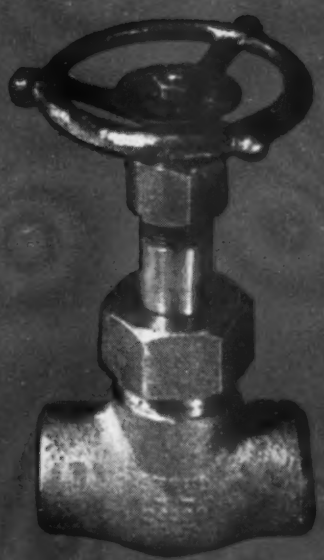
Straight-through

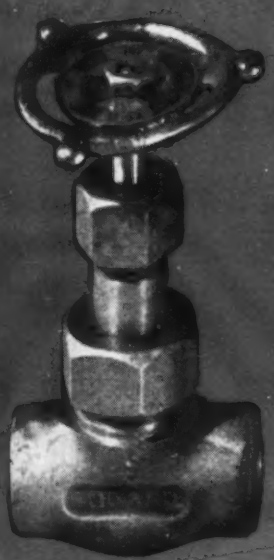
FLOW

for small pipe lines

For small lines where straight-through flow is required, here is an ideal valve. Especially suitable for sampling, viscous fluid and instrument line service.

Body and bonnet are forged steel and the disk is a truncated cone swivel plug, giving full contact against a borized conical seating surface. A diagonal pressure relieving hole is drilled below the disk to facilitate seating or unseating. It may also be used to open a passageway for cleaning out the valve.





Three styles are available

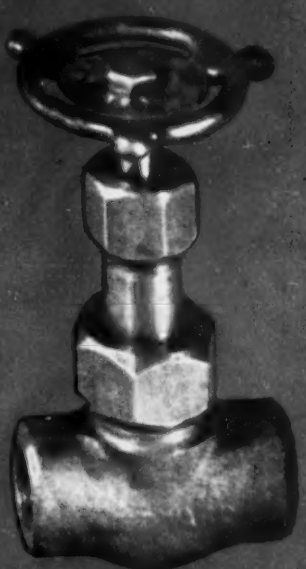
Fig. 150—Carbon steel body and bonnet, stainless steel trim.

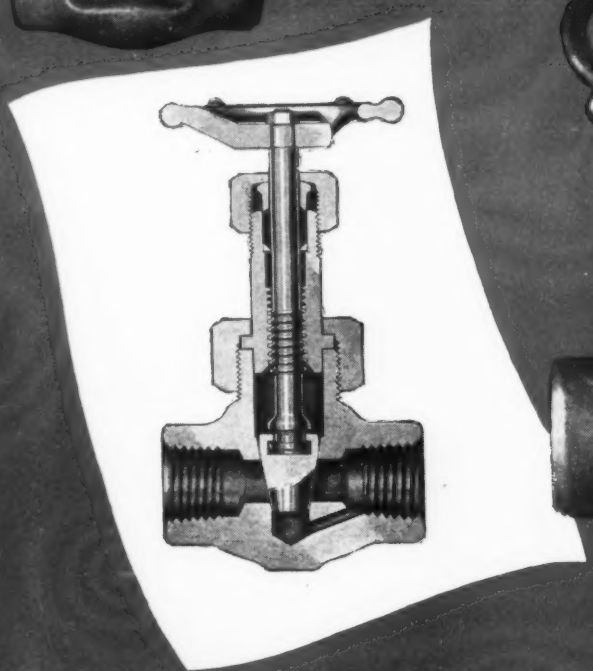
Fig. 2150—All stainless steel.

Fig. 4150—All "18-8" steel.

Built in ⅛ in. to 1 in. sizes inclusive.

Write for Catalog No. 103.





Edward Valves, Inc.

Subsidiary of Rockwell Manufacturing Co.

EAST CHICAGO, INDIANA

HOW TO TEST FOR SULPHITE IN BOILER WATER

By C A NOLL, *chief chemist, W H and L D Betz*

Photos by POWER

1 **Take the sample of water to be tested so that it has a minimum of exposure to the air. Do not filter it. Place 0.5 ml (about 10 drops) of concentrated hydrochloric acid in a casserole and add to it 100 ml of the sample of water.**

2 **Add 1.0 ml (about 20 drops) of starch indicator* and stir. Then titrate with standard potassium iodide-iodate solution (1 ml of which = 0.5 mg SO_3) from the burette until a permanent blue color develops: the true endpoint.**

▶ UNDER PROPER CONDITIONS sodium sulphite reacts with and removes dissolved oxygen from boiler water, but the use of this chemical as a deaerant is economical only within certain limits of dissolved-oxygen content. Safest practice is to remove as much oxygen as possible by mechanical means and then maintain a small sodium sulphite residual in the boiler water to take care of the remaining oxygen contamination.

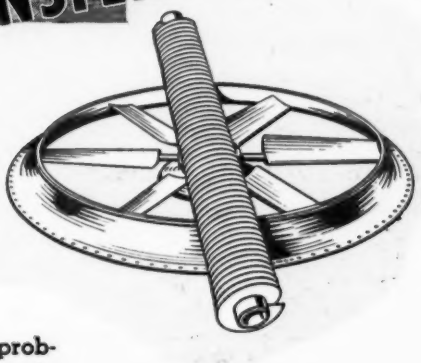
To assure rapid and complete removal of oxygen that enters with the feedwater a soluble or excess sulphite content of at least 20 ppm must be maintained. Residual can be determined by the easy-to-follow test shown above.

Calculation of results: Ml of potassium iodide-iodate used $\times \frac{500}{\text{ml of sample}}$ = ppm of sulphite as SO_3. Thus, using a 100-ml sample, the sulphite (in ppm as SO_3) is equal to the ml of potassium iodide-iodate required to develop a blue color, multiplied by 5.

Limitations of test: This method is slightly less accurate than the iodimetric test but is more rapid and better adapted to field use. It is affected by oxidizable substances such as organic matter, sulphides and nitrites, and their presence may cause the sulphite residual obtained from this titration to appear slightly higher than is actually the case.

* Starch indicator is not stable and should be made at least every three days, preferably every day. To 2 grams (½ teaspoon) of dry starch add 10 ml cold distilled water. Mix to a smooth paste and add to 100 ml of boiling distilled water. Stir vigorously and cool to room temperature before using in the sulphite test.

Air Cooling EXTENDED TO MANY HEAT TRANSFER SERVICES BY Fin-Fan



You can now eliminate water supply system expenses and problems, and obtain reliable low cost cooling and condensing in a wide variety of services, with the FIN-FAN Air-Cooled Heat Exchanger.

This "package type" unit . . . a joint development of The Griscom-Russell Co. and The Fluor Corporation, Ltd. . . . can be used for liquids, gases or vapors at pressures up to 5,000 psi and temperatures up to 1500-F, operates efficiently at any air temperature, can be installed wherever convenient, and a single installation can be arranged to handle multiple duties.

FIN-FAN Exchangers are performing satisfactorily such services as condensing steam and still overheads, and cooling gases, jacket water, and other liquids. Write for complete information on its many distinctive features and advantages, and their application to individual condensing or cooling services in which you are interested.

The above sketch symbolizes the principle of the FIN-FAN Air-Cooled Heat Exchanger which combines the long Griscom-Russell experience in the field of heat transfer equipment and the extensive Fluor experience in air-moving systems, mechanical equipment, and structures.

THE GRISCOM-RUSSELL CO.
285 Madison Ave., New York 17, N. Y.

GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus

FOR THE ENGINEER'S BOOKSHELF

BOOKS REVIEWED IN THIS ISSUE

APPLIED ENERGY CONVERSION • LESSONS IN ARC WELDING
PRINCIPLES OF INDUSTRIAL PROCESS CONTROL
ASME MECHANICAL CATALOG AND DIRECTORY
ELEMENTARY ENGINEERING ELECTRONICS • SUB-ATOMIC PHYSICS
ELECTRIC CIRCUITS AND MACHINES • ELECTRONICS DICTIONARY
ARCTIC AND WESTERN HUDSON BAY DRAINAGE
BASIC ELECTRICAL ENGINEERING • INTERNAL COMBUSTION ENGINES
AMERICAN MACHINISTS' HANDBOOK

Industrial-Process Control

PRINCIPLES OF INDUSTRIAL PROCESS CONTROL (1945) *By Donald P Eckman, engineering dept, The Brown Instrument Co.* 237 *pp*, 5½x8¼ *in., illustrated, cloth,* $3.50. *John Wiley & Sons Inc,* 440 *Fourth Ave, New York* 16, *N. Y.*

The growing importance of instrumentation and control to modern industrial processing has been acknowledged by the addition of courses on this subject to the curricula of engineering colleges and technical schools.

Primarily, this book is intended for the student in chemical, metallurgical or electrical engineering. The author covers the important laws of operation of control systems and provides the necessary background of theory. Mechanical details of measuring devices and controlling mechanisms are brought out only when they are necessary to the analysis of principles and characteristics of operation. The importance of proper measurement is emphasized because of its great influence on automatic control.

The book is written so that it may be used as a training manual in an industrial plant or a textbook for college courses in instrumentation and automatic control.

Electronics

ELEMENTARY ENGINEERING ELECTRONICS (1945) *By Andrew W Kramer, Managing Editor, Power Plant Engineering.* 344 *pp,* 5x8, 259 *illustrations, cloth,* $2. *Published by Instruments Publishing Co,* 117 *Wolfendale St, Pittsburgh* 12, *Pa.*

Here is another elementary book that is a valuable contribution to electronics. The material originally appeared as a series of articles in *Power Plant Engineering* and later was rewritten, brought up to date and published in *Instruments.* Beginning with an explanation of the nature of electricity as a foundation the author explains how the different types of commercial electron tubes work and how they are used in a wide range of industrial and other applications.

Among the subjects treated in the 36 chapters are: Two- and 3-element tubes and their use as amplifiers; ionization; the thyratron, how it works and is controlled; development of electron-tube oscillators and types of oscillating circuits; principles and characteristics of tetrodes, pentodes, phototubes and photovoltaic cells; mercury arc rectifiers; cold-cathode tubes; electronics in measuring devices; and sensitive-contact electronic-relay circuits.

Mathematics have been eliminated from the treatment of practically all the subjects, making the book well suited to those needing an elementary text on electronic tubes and circuits.

Mechanical Equipment

ASME MECHANICAL CATALOG AND DIRECTORY (1946) *Thirty-fifth annual volume.* 822 *pp,* 8½x11⅜, *illustrated, cloth,* $3 *to non-members. The American Society of Mechanical Engineers,* 29 *West* 39*th St, New York* 18, *N. Y.*

A reference work for buyers and users of industrial equipment. Contains product descriptions of about 350 manufacturers, and comprehensive directory of nearly 5000 manufacturers indexed under product classifications. For easier reference there is also included a directory of trade names. Listing includes all types of power equipment as well as supplies, machine tools, accessories, instruments, processing equipment and so forth.

Basic Physics

SUB-ATOMIC PHYSICS (1943) *By Herbert Dingle, professor of natural philosophy at Imperial College of Science and Technology (University of London)* 272 *pp,* 5x7¼, 147 *fig, cloth,* $2.25. *Ronald Press,* 15 *E* 26*th St, New York, N. Y.*

One of a group of individual treatments of basic sciences most essential to an understanding of aeronautics, this selection is for British training programs of military personnel. Treatment, however, remains entirely within the field of physics embracing (1) light (2) electricity (3) magnetism.

With full realization of the varied backgrounds of its intended readers, the author keys his subject matter to a general educational level as a starting point and a well-grounded scientific understanding for future study as a desired goal.

An entire chapter devoted to the structure of the atom proves most timely. Its position as lead chapter signifies both the thoroughness of subject treatment and the highly modern approach.

A system of questions at the end of each chapter serves as a measure of the grasp of preceding material. In each case this material is presented to achieve a maximum clarity and where deemed most helpful, mathematics aids in establishing a point.

Arc Welding

LESSONS IN ARC WELDING *Seventh printing, second edition,* 176 *pp,* 5½x8½ *in.,* 133 *illustrations, cloth* 50¢ *in U. S., elsewhere* 75¢. *The Lincoln Electric Co, Cleveland, Ohio.*

Published with the objective of aiding both new and experienced welders to use the process successfully and economically, the text consists of a series of 61 separate lessons. A list of questions and answers for each lesson facilitates self-examination.

Subjects are too numerous to mention but the book covers every angle of practical welding, the instructions being based on the experience of Arthur Madson, head instructor in the Lincoln Arc Welding School.

Arrangement and contents make this book an admirable text for training new welders because it breaks the subject of arc welding into small lessons, each covering one particular phase of the subject.

Power Plant Engineering

APPLIED ENERGY CONVERSION *first edition, By B G A Skrotzki, assistant editor,* POWER, *and W A Vopat, assistant professor of mechanical engineering, The Cooper Union School of Engineering.* 502 *pp,* 6x9, 208 *figures, tables, cloth,* $5. *McGraw-Hill Book Co,* 330 *W* 42*nd St, New York* 18, *N. Y.*

Intended to give a picture of present and possible future methods of power generation, this book confines itself to describing the general arrangements and functions of power equipment without considerations of design problems. Methods of choosing between various prime movers are outlined by presenting the fundamentals of engineering economics together with the elements of load curves, capacity requirements, performance curves, and load division. These factors are

(*Continued on page* 174)

Small Units Achieve High Rate of Heat Transfer

... thanks to unique design and use of COPPER

"Heliflow" Coolers and Heaters are made in a range of sizes. From left to right is shown a progression from smallest to largest unit. View at right shows coils of Anaconda Copper Tubes being installed in Heliflow casing.

ACCORDING to the Graham Manufacturing Company, Inc., New York, these "Heliflow" Coolers and Heaters possess an exceptionally high rate of heat transfer, are unusually compact, easy to clean, and are designed with a minimum number of joints.

They have an extremely wide range of application, including such uses as lube oil coolers, boiler and evaporator blow-down heat exchangers, feed water and water supply heaters, fuel oil heaters, and similar uses for which their capacity range of 1½ to 60 sq. ft. renders them suitable.

For most applications, "Heliflow" units are equipped with coils fabricated from Anaconda Copper Tubes. Where extremes of pressure, temperature, or other conditions demand extra strength or resistance to specific corrosive agents, copper-base alloy tubes are employed.

Anaconda Condenser and Heat Exchanger Tubes in copper and 10 different copper alloys are available for heat transfer requirements. Manufacturers and users of such equipment are invited to utilize the metallurgical knowledge and practical experience of our Technical Department. For detailed information, write for Publication B-2. 45129

ANACONDA

Anaconda Heat Exchanger Tubes

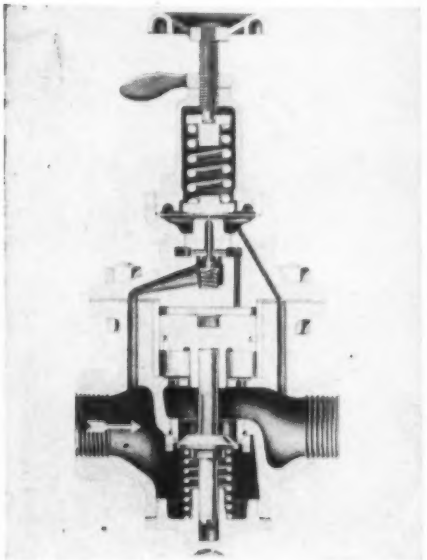
THE AMERICAN BRASS COMPANY—General Offices: Waterbury 88, Connecticut

Subsidiary of Anaconda Copper Mining Company • In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*

WHAT'S New IN PLANT EQUIPMENT

Air-Reducing Valves

MAIN FEATURES of internal pilot-operated air-reducing valve, known as Class L-1A, are its stability under all flow conditions and its responsive, instant reaction to wide and sud-



den variations in load. Plastic inserts in valve seats provide positive tight shutoff and long life. Valve is available in sizes ½ through 4 in., designed for initial pressures up to 400 psi air pressure and reduced pressures from 5 to 300 psi.

Class JA-1 valve, for control of small air valves, is similar in construction to Class L-1A except that a neoprene diaphragm is used instead of a bronze piston. This valve has the same initial pressure range and controls reduced pressures from 1 to 300 psi. **Leslie Co, 255 Grant Ave, Lyndhurst, New Jersey.**

Magnetic Drive

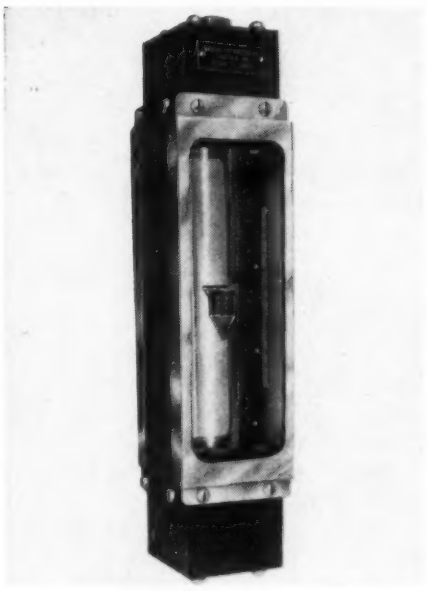
PRECISE, WIDE-RANGE, quick-response speed control results from 2-element magnetic drive. *E-M* adjustable-speed drive consists of a rotating ring and a rotating magnet built in several forms and ratings of about 25 hp and larger at 1800 to 600 rpm. **Electric Machinery Mfg Co, Minneapolis 13, Minnesota.**

Dry Transformer

COMPACTNESS AND LIGHT WEIGHT permit placing 80-C-rise dry transformers on posts, walls, overhead and on machines in a wide range of applications. Fireproof vaults are unnecessary for inside building applications as no insulating liquids or combustible materials are utilized. Units through 25 kva are impregnated, core and coil, by a vacuum-pressure process to guard against moisture and dirt. Over 25 kva, coils alone are impregnated. Employing Class B insulating materials, new single- and 3-phase models are available in ratings from 1½ to 300 kva. **Allis-Chalmers Mfg Co, Milwaukee, 1, Wisconsin.**

Compact Boiler

BADENHAUSEN BOILERS are compact in design which makes it feasible to provide a larger grate and furnace area. With furnace area and grate in direct proportion to required heat release, these units perform to rated standard, without forcing. Easy cleaning is made possible by overhead position of steam drum with which both primary and secondary tubes are directly connected. **John Phillips Badenhausen, Inc, 1814 Packard Bldg, Philadelphia 2, Pa.**



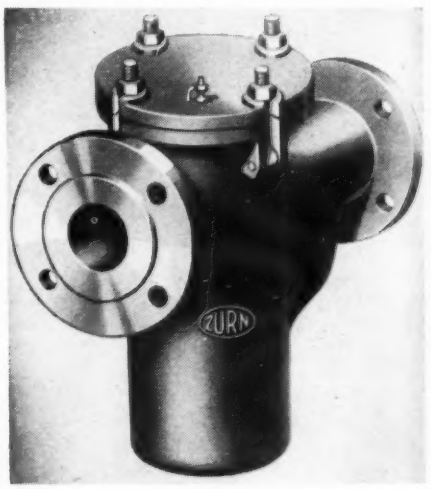
Full-View Rotameter

FEATURES OF METER are the following: (1) It is equipped with an interchangeable *Tru-Taper* precision-metering tube. (2) Space between side plates is so wide that the float position can be easily read. (3) Metering tube is easily replaced without taking meter out of line. (4) End fittings are universal for connections in four directions, 90 deg apart. (5) Square shape of meter makes it easy to panel mount with simple inexpensive right-angle brackets. (6) Meter parts are carefully specified and treated to prevent external corrosion. (7) Meter is *Safety-Shielded* with a full, leakproof inclosure that protects operator and allows him to read meter with complete safety.

Meter, in iron, brass and stainless steel, is available in sizes from ⅛ to 4 in. with screwed or flanged connections. With a metal tapered tube, it serves for pressures as high as 600 psi. Meter can be obtained as a simple flow-rate indicator or with remote instrument for recording or recording-controlling flow rate. Flow totalization can also be included. **Brooks Rotameter Co, P O Box B-1219, Lansdale, Pa.**

Pipeline Strainer

ZURN PRESSURE AND SUCTION PIPELINE STRAINER, in cast bronze, steel, semisteel, iron or alloyed metals, maintains maximum liquid flow through piping systems while protecting pumps and moving parts of other vital equipment that might be injured by foreign particles. Maximum liquid flow is said to be



assured as total area of strainer-basket perforations exceeds the area of the opening of inlet by more than a 1.5 ratio. Air-pressure relief valve on unit cover permits escape of air that builds up within the unit and impedes operation of strainer and other pipeline mechanisms.

Unit can also be furnished with a magnetized strainer basket for intercepting ferrous-metal particles too small to be intercepted by strainer. High-pressure strainers have a removable drop-bolted cover while low-pressure strainers have yoke-clamp covers. Strainer basket is removed for cleaning. Unit is also available with a clean-out plug for blowdown cleaning when practical. **J A Zurn Mfg Co, Erie, Pa.**

Flame Guard

POSITIVE, INSTANTANEOUS, electronic safeguard against failure comes from use of *Fireye* flame-failure detector Type F18T, its manufacturer claims. Basis for operation is photoelectric, with phototube and amplifying system housed in dust-tight aluminum case. Photoelectric cell observes flame through a 2-in. pipe connection employing filters that

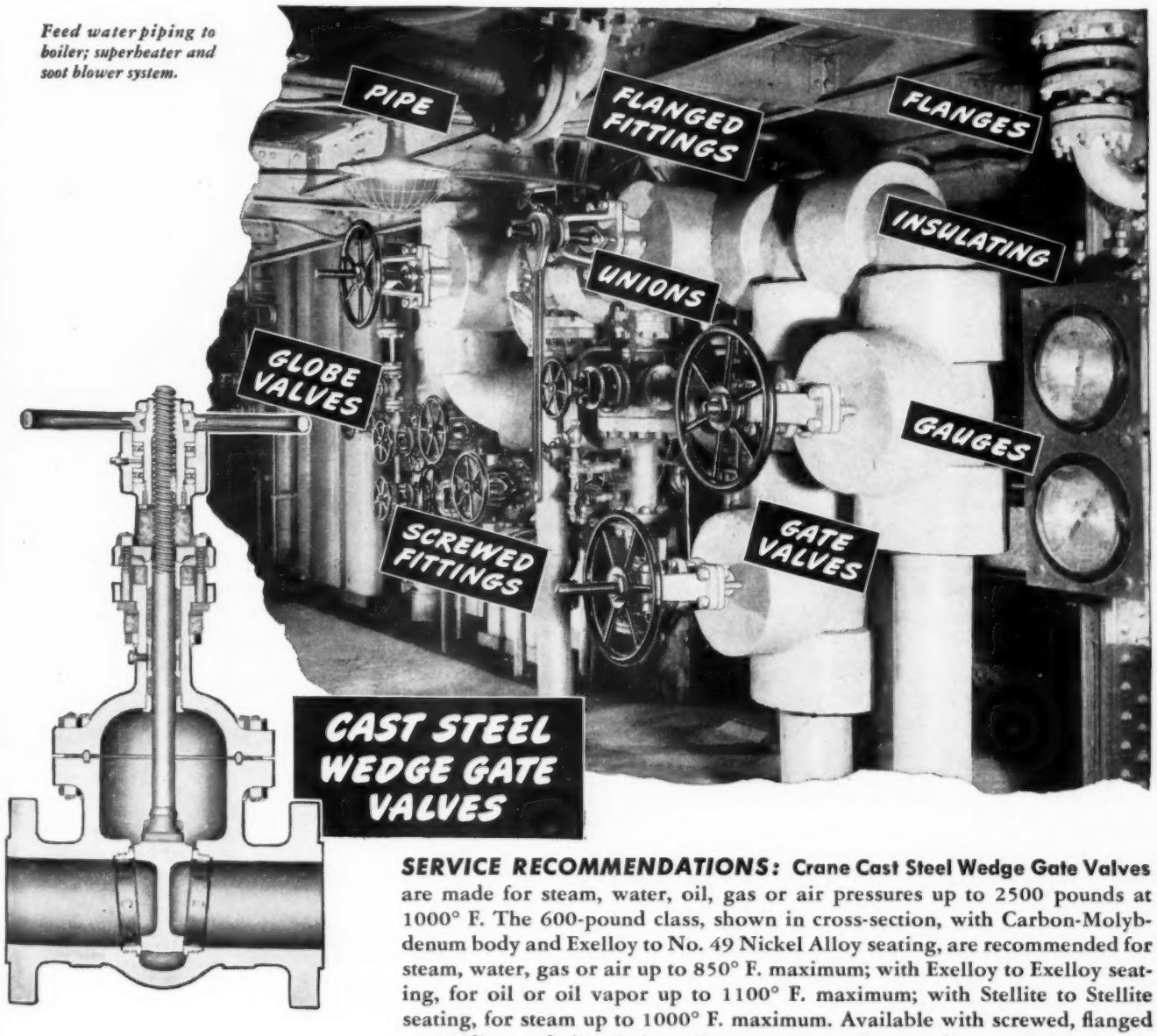
How CRANE Helps Solve Your Piping Equipment Problems

ONE SOURCE OF SUPPLY • ONE RESPONSIBILITY • ONE STANDARD OF QUALITY

If all piping systems worked under the same conditions, the above statement wouldn't mean much. The fact is that you alone can determine the exact requirements governing your choice of piping materials. Here is the vital distinction of the Crane line as a truly helpful service. First, Crane helps by giving you the world's most complete selection of piping equipment for all applications. Then, by making clear the relevant advantages of each type, Crane, with 90 years' experience, helps you choose with complete confidence.

Ordering is simplified—your local Crane Branch or Wholesaler supplies all your needs. Uniform quality in all materials—backed by single responsibility—insures the best installation and peak performance. Stop and think how this service fits your reconversion plans.

Feed water piping to boiler; superheater and soot blower system.



SERVICE RECOMMENDATIONS: **Crane Cast Steel Wedge Gate Valves** are made for steam, water, oil, gas or air pressures up to 2500 pounds at 1000° F. The 600-pound class, shown in cross-section, with Carbon-Molybdenum body and Exelloy to No. 49 Nickel Alloy seating, are recommended for steam, water, gas or air up to 850° F. maximum; with Exelloy to Exelloy seating, for oil or oil vapor up to 1100° F. maximum; with Stellite to Stellite seating, for steam up to 1000° F. maximum. Available with screwed, flanged or welding ends in all sizes. See your Crane Catalog for specifications.

CRANE CO., General Offices: 836 S. Michigan Ave., Chicago 5, Ill. • *Branches and Wholesalers Serving All Industrial Areas*

CRANE

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

Equipment *Continued*

(1) keep equipment dust-tight (2) in conjunction with a baffle system protect *Fireye* from radiant heat.

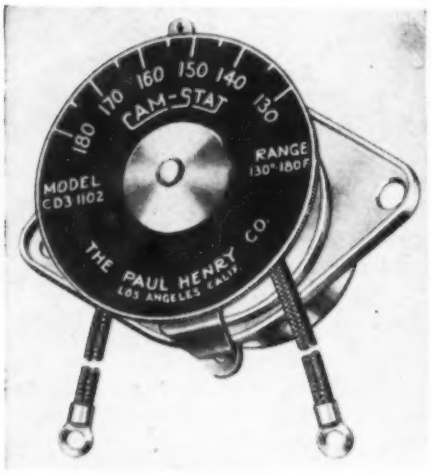
Phototube operates at high ambient temperature (32 to 150 F) with its control front within five ft of monitored flame. Entire assembly meets these specifications, 115 to 230 v, 50 or 60 cycle, ac, 10-watts power consumption, single pole, single-throw relay with a time-delay element to prevent operation during purely transient flame disturbances, 5 amp rating or $\frac{1}{6}$ hp at 230-v ac; weight, 12½ lbs. **Combustion Control Corp, 77 Broadway, Cambridge 42, Mass.**

Hand Tachometer

BLACK ENAMEL AND NICKEL-FINISHED tachometers operate on a centrifugal principle to give 5-range speed indications from 30 to 48,000 rpm; accurate, manufacturer states, within ½ of 1%. Designed for both right- and left-hand rotation, instantaneous speed fluctuations appear on a dial with inside and outside scales. Rotary gear permits scale selection for desired range. **Coats Machine Tool Co, Searsdale, N. Y.**

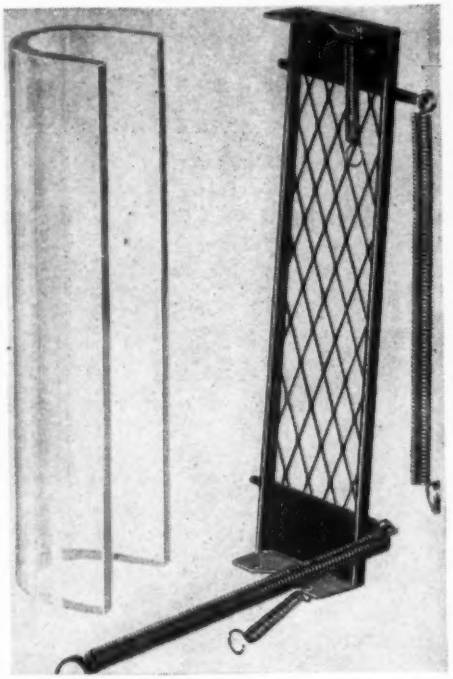
Sealed Gasket

SERRATED, MACHINED-METAL GASKET consists of two disks of *Armco* iron, low-carbon steel, monel or stainless steel whose external faces are welded together around their outer periphery. Line pressure enters gasket interior to exert an expansion pressure in excess of the required sealing force. *Bellowseal*, its manufacturers state, combines pressure and corrosion qualities of all-metal gaskets with light bolting requirements of softer sealing mediums. **Goetze Gasket & Packing Co, New Brunswick, N. J.**



Temperature Control

CAM-STAT TEMPERATURE CONTROL model shown has an adjustable range applicable to control of water heaters. A wide choice of adjustable ranges is also available between —50 and +600 F, with differentials as low as 1 F. *Cam-Stat* may be clamped on tank or element may be immersed in water. A wide variety of mounting means is available for adapting the unit to control of air, gas, liquids or solids. **Paul Henry Co, 2037 S La Cienga, Los Angeles, 34, Calif.**



Gage-Glass Protector

KLEERVU PROTECTOR consists of two simple parts—the metal frame, with four holding springs, and a quarter-inch thick transparent *Nuglas* cover. When installed, *Kleervu* incloses gage glass within a protective transparent cover so that should gage glass burst or explode, all flying, broken glass is safely confined within this shatterproof inclosure. Glass-clear cover encircles gage on three sides. In the back is a screened frame which holds cover and provides an open-vent area for escaping steam in case of gage-glass breakage, thus avoiding any pressure build-up within protector. *Kleervu* gage-glass protectors are now available in any desired length for tubular gage glasses on boilers, process tanks, chemical tanks, oil tanks, cookers, and other installations. **Wright-Austin Co, 371 W Woodbridge St, Detroit 26, Mich.**

Silicone Greases

HIGH-HEAT STABILITY, low volatility, low freezing point constitute requirements for ball-bearing lubrication at abnormally high and low temperatures. *DC* 31 and *DC* 41, compounded from inorganic materials, do not melt even at 480 F, are waterproof and resistant to oxidation. Both greases possess some electrical conductivity of about 1000 ohm centimeters. *DC* 33 and *DC* 44, compounded from metallic soaps, possess a high heat stability coupled with a good lubrication quality from —95 to +300 F, and are used on ball bearings at speeds up to 10,000 rpm. **Dow Corning Corp, P O Box 592, Midland, Mich.**

Alloy Steel

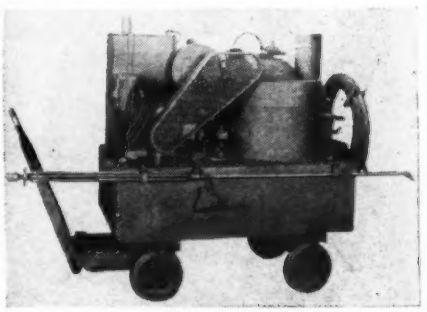
LOW-ALLOY HIGH-TENSILE STEEL meets requirements for light-weight stock in railroad or general transportation field. *Dynalloy* possesses, its manufacturer claims, high anti-corrosive qualities. Its elastic limit is 50,000 psi. **Alan Wood Steel Co, Conshohocken, Pennsylvania.**

Light Bulb

NEW PROCESS treats the glass on inside of white light conditioning bulb to diffuse central glare point caused by the concentrated filament, with result that the direct raw light rays are broken up into millions of softer "counter diffusing" light rays that glow evenly over entire bulb surface, without sacrifice of visible illumination. Ten sizes from 10 to 200 watts will be made in 115, 120 and 125 v, with four sizes from 25 to 150 watts in 220, 230, 240 and 250 v. **Wabash Appliance Corp, 335 Carroll St, Brooklyn, N. Y.**

Finishing Varnish

No. 238 BLACK AIR-DRYING VARNISH is of a non-pigmented formulation, thereby preventing settling out of color when stored for any period of time. It is flexible, oilproof and possesses high wet and dry dielectric strength. No. 238 does not require a special thinner. For reduction purposes, mineral spirits (turpentine substitute) may be used. **John C Dolph Co, 168 Emmett St, Newark 5, N. J.**



Cleaning Unit

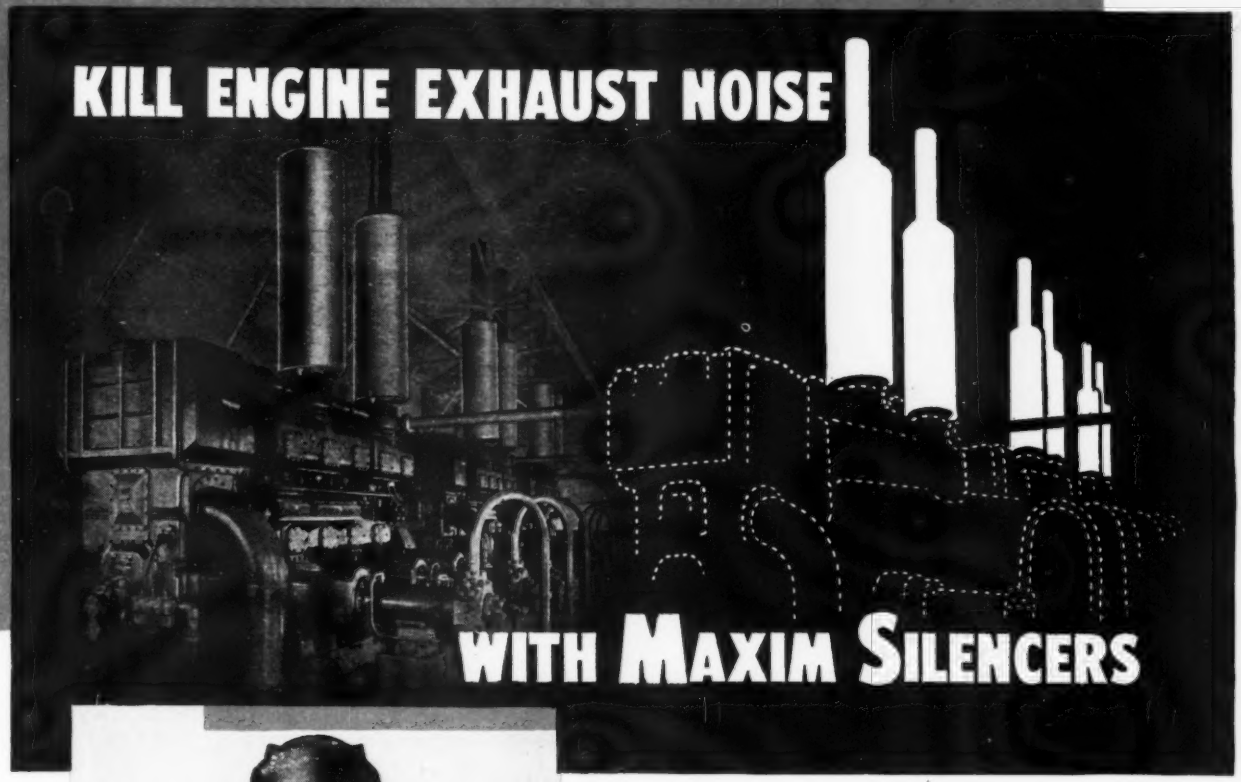
OAKITE-VAPOR CLEANING UNIT is a self-contained down-draft flame, oil-fired inclosed-coil steam generator that delivers hot vaporized cleaning solutions under selective pressures up to 200 psi for speedy, easy removal of grease, grit, grime, paint and other deposits from surfaces. A wide range of fuel oils, such as No. 1, 2 or 3 fuel oil, kerosene or gasoline, may operate the unit. **Oakite Products, Inc, 23 Thames St, New York 6, N. Y.**

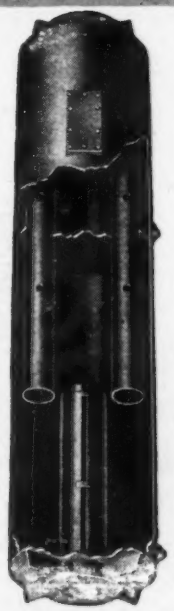
Repeat-Cycle Timer

A RUGGED INDUSTRIAL ELECTRONIC TIMER for machinery and process control, Type 2T15U is for applications requiring two adjustable timing periods to run in a continuous cycle. Either momentary or sustained contact initi-

(*Continued on page* 158)

KILL ENGINE EXHAUST NOISE WITH MAXIM SILENCERS





Maxim Exhaust & Intake Silencers silence the exhaust or intake of internal combustion engines, steam engine exhaust, compressor intake, vacuum pump discharge and the intake or discharge of blowers of the positive pressure type. Spark arresting included where necessary.

Adequate silencing of engine exhaust noise is an operating necessity today. The engines shown above could, without proper silencing, make a public disturbance that would quickly be felt by those in charge of plant operation. With Maxim Silencers, however, exhaust noise can be reduced to a point where it is scarcely audible.

Maxim engineers will be glad to recommend the correct silencing equipment to best meet your particular problem. Send your specifications to the address given below.

Maxim also makes Heat Recovery Silencers which combine efficient silencing, spark arresting, and the recovery of waste exhaust heat to produce steam or hot water for heating or processing operations. These are described in Heat Recovery Bulletins WH 100, WH 101 and WH 103.

WRITE FOR BULLETINS describing exhaust & intake silencers D 125, D 127, D 101, D 37.

THE MAXIM SILENCER CO. 92 HOMESTEAD AVE., HARTFORD, CONN.

ARMY E NAVY

MAXIM

POWER NEWS

BUSINESS ITEMS AND APPOINTMENTS • WASHINGTON NOTES

FOREIGN FIELDS • MODERNIZATION • FUEL CONSERVATION

Propose Halving Jap Power Potential

► U. S. Reparations Commissioner Edwin W Pauley plans as an "interim reparations program" that Japan be stripped of half its steam-generating capacity. This recommendation will be made to President Truman upon Pauley's return.

Informed Washington sources say that this proposed recommendation and other ideas expressed in a statement released in Tokyo are strictly those of Pauley and until ratification by the White House must be termed unofficial. These same sources advance no reason to believe, however, that this program will necessarily be discarded in favor of any less drastic action.

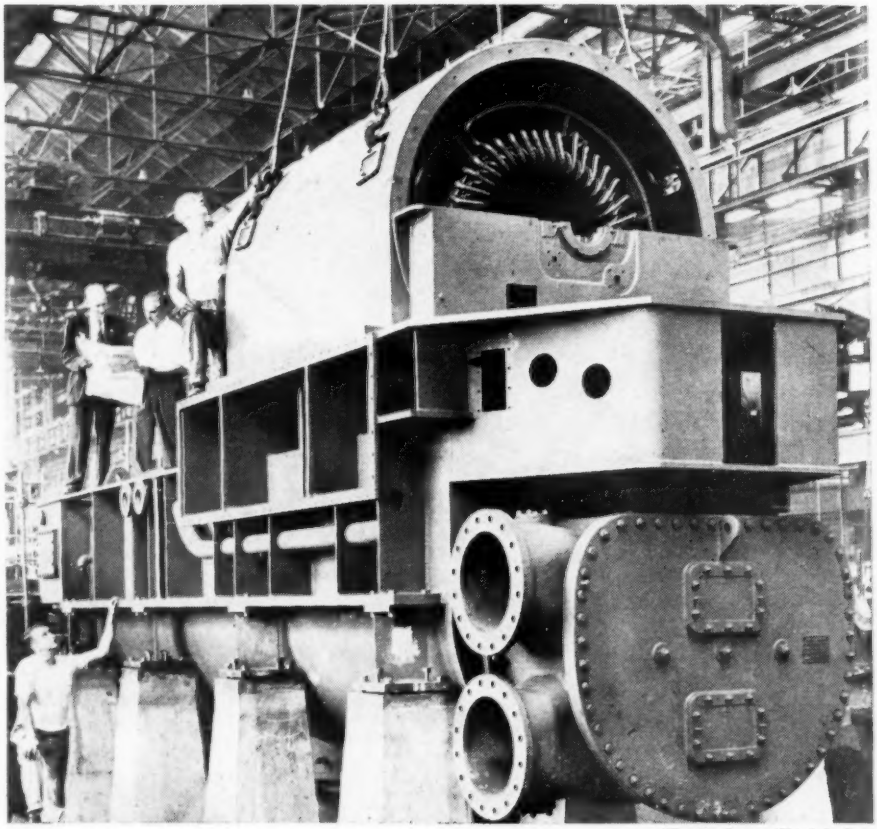
In his Tokyo release Pauley recommends that half the coal-burning generating stations be left in place to firm-up Japanese hydro capacity. This reduction in power potential is only part of a much broader program based on the same policy adopted in Germany, that of utter destruction for the war-making industrial potential of the defeated aggressors, and limitation of other industrial facilities.

With only meager data available on the power system of the Japanese home islands, it is highly questionable how much of the U. S. reparations objective can be attained by removal of half the steam capacity.

In 1944 Japan's 12,000,000-kw capacity consisted of 6,500,000 kw in hydro installations, most of it "run of the river," and the remainder in steam-electric stations, virtually all coal fired.

Many factors other than straight arithmetic, however, affect the actual result. For instance, removing the most efficient stations and leaving only those so located as to be beyond transmission distance of industrial load centers would limit production out of all proportion to the change.

One Army officer, Lt Col Karl Enz, on leave from the China Corporation, and a veteran of 20 years as engineering consultant in Japan for foreign financial interests that helped develop the Japanese power system, is now engaged in power control in Japan. On the basis of his intimate knowledge of the country's power system, a comment accredited to him is most interesting: that destruction of 50 picked plants would bring Japanese industry to a halt almost at once.



Westinghouse Electric Corp

COMPACT UNIT GIVES QUICK POWER

Steam turbine, condenser, generator and auxiliaries comprise components of a 5000-kw, integrated, highly simplified power plant that operates from a 600-psi 825-F steam supply. Combination consists of standard, thoroughly tried power units, occupying a floor space of 31x13 ft in area and standing 17½ ft high. The condenser, capable of developing a 28-in. vacuum under design conditions, serves as a foundation superstructure upon which rests turbine, generator and auxiliaries

Three-Way Ownership Aids Portuguese Hydro

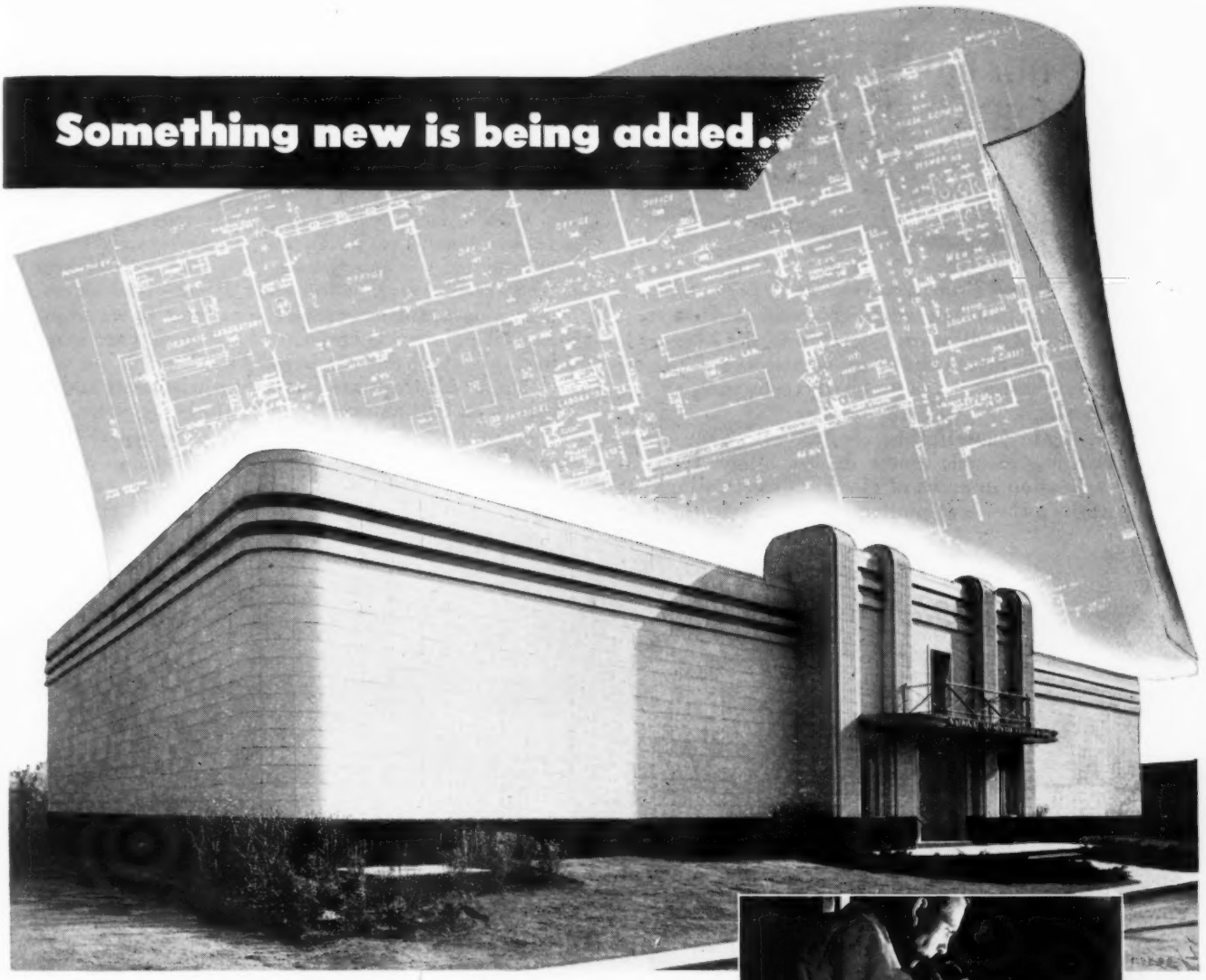
Lisbon (*McGraw-Hill World News*): A series of new hydroelectric projects for Portugal rest on a financial framework formed by one-third shares, held by (1) government (2) utilities and (3) the general public.

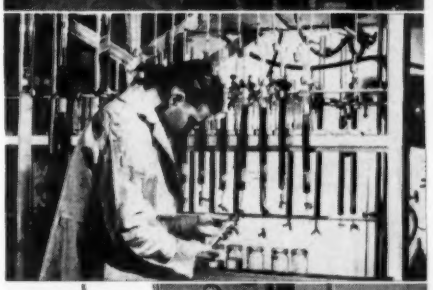
Two hydro companies formed from this combine, one in the north at Oporto, the second in the south at Lisbon, mark the materialization of long considered plans made imperative by coal shortages brought on by the war.

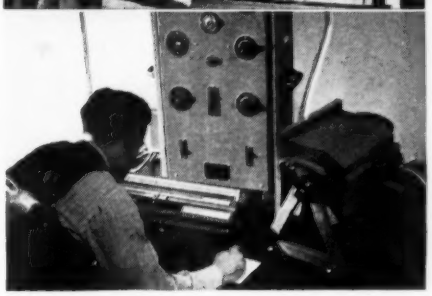
In the industrial north on the Rabagao River's Venda Nova dam, work is under way on the first phase of the $5,600,000 4-dam 40,000-kw capacity project. Upon completion, four years hence, 145,000,000 kwhr per year will be delivered but partial operation is expected in three years. Future plans for the northern section call for dams on the Cavado River

(*Continued on page* 180)

Something new is being added...







to make the *Nalco* System of water treatment an even *greater* service to industry

Not content with the world's finest and most modern water treatment laboratories . . . Nalco is now enlarging its research and laboratory facilities to make the Nalco organization even further advanced in the science of water treatment.

New technological and manufacturing processes springing up in this postwar era are bringing with them new problems in water treatment . . . *Nalco will be ready to help you solve these problems!*

Keeping well *ahead* of your water treatment problems has always been an aim of the Nalco organization. Our trained engineers and chemists and our entire research and laboratory facilities are at your disposal. Just ask for a Nalco survey . . . we will do the rest.

NATIONAL ALUMINATE CORPORATION

6222 West 66th Place • Chicago 38, Illinois

Canadian inquiries should be addressed to Aluminate Chemical Ltd., 555 Eastern Ave., Toronto, Ont.

Nalco —The System of Scientific Water Treatment for all Industry

How to plan

FUEL OIL PREHEATER AND PUMP CONNECTIONS

Another in the series of basic Piping Layouts prepared by Jenkins Bros.

Preheaters and Pumps are necessary for conditioning fuel oil for furnaces used for heating or power.

Continuous Circulation to and from the burners is provided in this layout showing preheaters and pumps in lines originating at, and finally returning to the storage tanks.

A Duplicate Installation of fuel oil pumps, one steam and one electric motor driven, allows for continued operation in event of electric power failure. It also permits a choice of motive power to gain the best overall economy. The electric pump is controlled through the pressure relief valve which allows direct return of oil to the storage tank when the demand for oil is not equal to the pump capacity. The steam-driven pump is controlled directly by oil pressure which regulates the admission of steam to the steam cylinder of the pump. An excess pressure connection for this pump is also provided.

Any Two Preheaters of the three provided have sufficient capacity to heat the maximum demand of fuel oil, thus allowing the shut down of one for repairs.

Oil Separators are provided to make sure that the return steam from the fuel oil preheaters and the steam cylinder of the pump does not carry fuel oil into the feedwater system. Bleeds for all the preheaters and pump permit discharging the exhaust to waste in case any oil polution is suspected. Separators are arranged in duplicate so one can be used while the other is being cleaned. All traps are hooked up with tests and check valves, and all automatic valves have bypasses.

Bronze Globe Valves of the regrind-renew type, for the usual pressure of 250 psi., are recommended for the oil lines. The steam valves shown are for 200 psi. steam—regrinding type globe valves and OS&Y Gate

GLOBE VALVE

CHECK VALVE

Jenkins PRACTICAL PIPING LAYOUTS

Illustrating the proved 3-point formula for trouble-free, time-defying hookups

1. **Place valves correctly in the line.**
2. **Use the right type valve for the service.**
3. **Choose Jenkins Valves for lifetime economy.**

7

Fig. 275
Outside Screw and Yoke
Bronze Gate Valve

valves, which have been chosen because of the need for immediate, positive operation.

Many Types and Pressure Ranges of Jenkins Valves other than those shown can be used for this type of layout, according to the factors involved. Consultation with accredited piping engineers and contractors is recommended when adapting these suggestions to your own requirements or when planning any major piping installation.

Copies of Layout No. 7 will be furnished on request by Jenkins' Engineers . . . also copies of future Piping Layouts. Just fill out and send the coupon.

Fig. 275, an Outside Screw and Yoke Bronze Gate Valve, used in this layout, is made with the extra stamina to withstand the effects of frequent operation, and give long, trouble-free service. The rising spindle, with threads out-side the valve where they are easily accessible for lubrication, serves as an indicator of the wedge position.

A CHOICE OF OVER 600 JENKINS VALVES

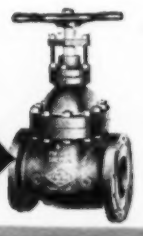
To save time, to simplify planning, to get the advantage of Jenkins specialized valve-engineering experience, – select all the valves you need from the Jenkins line, described in the Jenkins catalog, No. 76. It's your best assurance of the lowest cost in the long run.

Jenkins Bros., 80 White Street, New York 13; Bridgeport, Conn.; Atlanta, Boston, Philadelphia, Chicago, San Francisco. Jenkins Bros., Ltd., Montreal, London.

JENKINS VALVES

LOOK FOR THE DIAMOND MARK
SINCE 1864

TRADE JENKINS MARK



125 TO 600 LBS. PRESSURE

Jenkins Bros

BRONZE ★ IRON ★ STEEL

FOR EVERY INDUSTRIAL, ENGINEERING, MARINE, PLUMBING–HEATING SERVICE
SOLD THROUGH RELIABLE INDUSTRIAL DISTRIBUTORS EVERYWHERE

FUEL OIL PREHEATER AND PUMP CONNECTIONS

VALVE RECOMMENDATIONS

For details – and valves to suit varying conditions – see Jenkins Catalog.

Code	Quan.	Jenkins Valves	Service
A	16	Fig. 970 Regrind-Renew Br. Globe	Oil Lines
B	13	Fig. 950 Regrinding Br. Globe	Steam Lines
C	15	Fig. 275 O.S.&Y. Br. Gate	Steam Lines
D	5	Fig. 92 Bronze Swing Check	Steam Lines

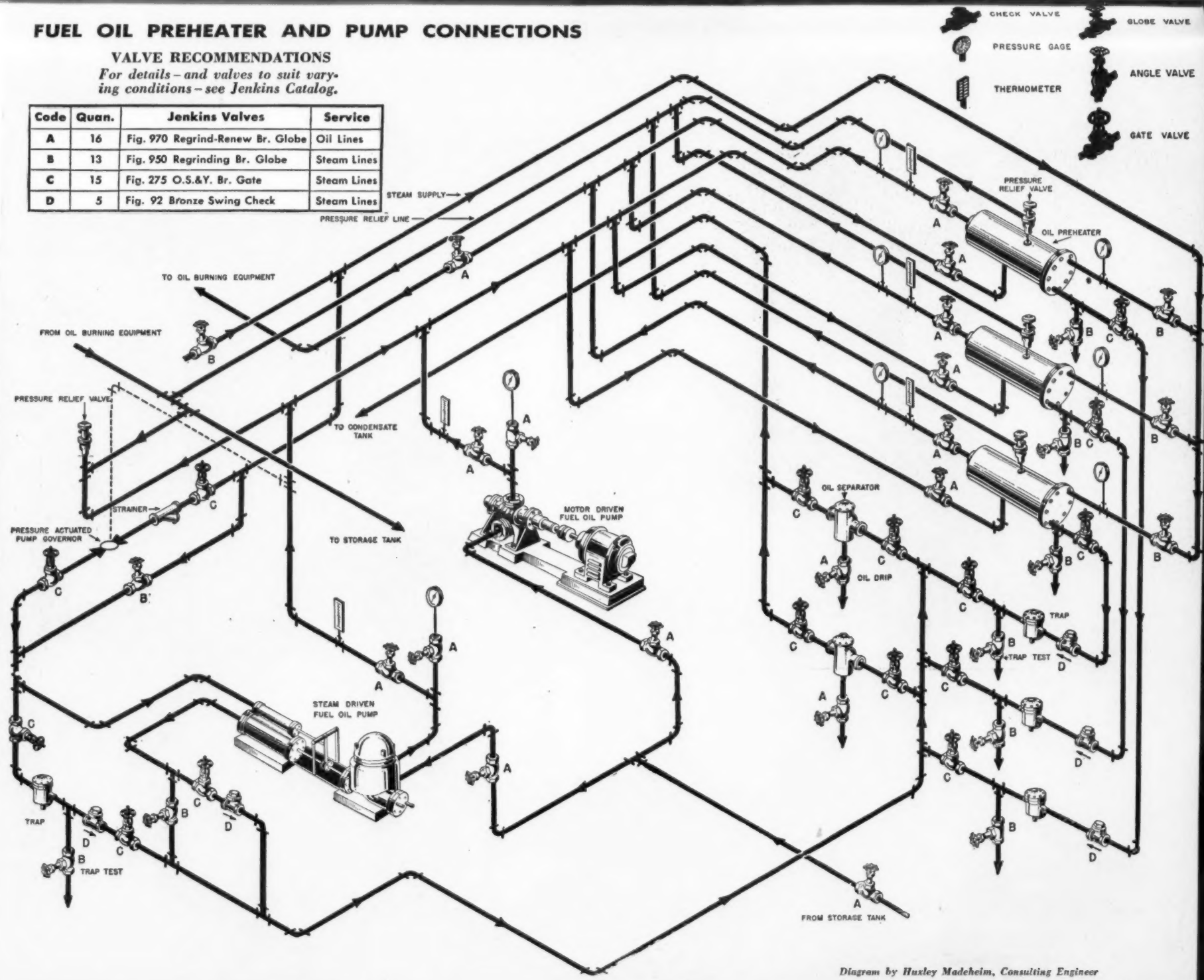


Diagram by Huxley Madeheim, Consulting Engineer

JENKINS BROS., 80 White St., New York 13, N. Y.

Please send me a reprint of Piping Layout No. 7, and future Layouts as they become available.

Name

Company

Address

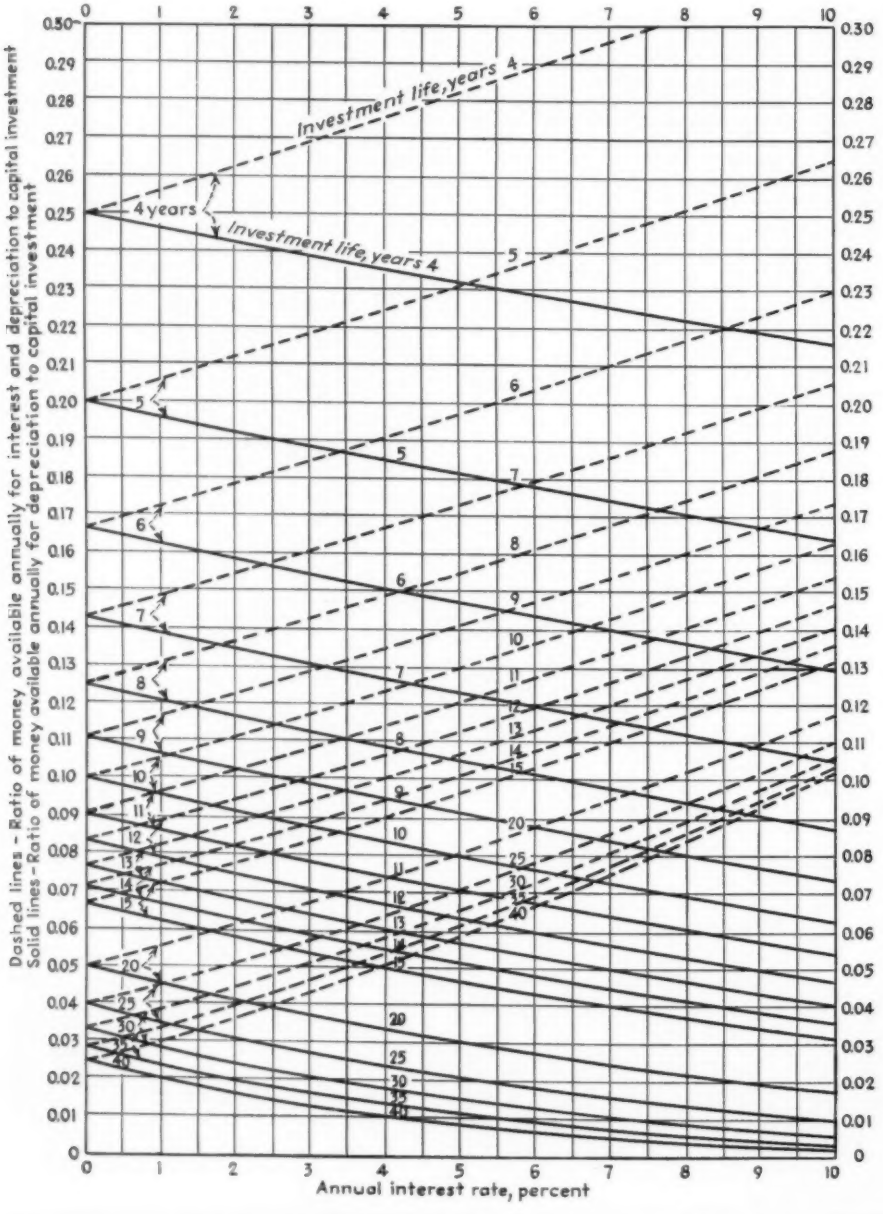
POWER'S
DATA SHEETS

Number 162

Interest and Depreciation Rates

▶ In evaluating different methods of power production and the selection of power equipment one of the most frequently used systems estimates the rate of return or interest on the money invested. Of course, such estimates are no more precise than the predictions on which they are based. As a safety factor it is usual practice to select only schemes that show considerably higher interest rates than are considered a desirable minimum rate of return.

Based on the well-known annuity tables, the chart helps quick estimating of interest and depreciation, or amortization rates, and other related factors.


Dashed lines - Ratio of money available annually for interest and depreciation to capital investment
Solid lines - Ratio of money available annually for depreciation to capital investment
Investment life, years 4
4 years
Investment life, years 4
Annual interest rate, percent

Example 1: Studying replacement of an old boiler with a more efficient one costing $81,700 installed shows net annual savings available for depreciation and interest of $8600. To find interest rate on this investment for assumed 15-year life determine ratio of savings to investment = 8600/81,700 = 0.105. In the chart look for intersection of 15-year *dashed curve* with 0.105 and find 6.3% interest rate as return on investment. This method of evaluation assumes that the annual amortization payments are invested to earn the same interest rate as the original investment yields, in this case 6.3% compounded annually. Annual amortization rate = 0.105 − 0.063 = 0.042, or 4.2% of original investment.

Example 2: An industrial plant estimates that it will save $10,000 yearly (applicable to interest and amortization) by installing its own generating plant at a cost of $77,000 instead of purchasing energy from other sources. Investment life is taken as 10 years. Annual amortization payments will have to be invested in a sinking fund earning 2% compound interest.

To repay $77,000 in ten years at 2% compound interest the amortization rate is found at intersection of 10-year *solid curve* and 2% interest ordinate, a value of 0.091, or 9.1%. Annual amortization = 0.091x77,000 = $7000. Annual interest = 10,000 − $7000 = $3000; and interest rate = 3000 ÷ 77,000 = 0.039, or 3.9%.

Example 3: Installation of an ash-sluicing system costing $10,000 will save $2000 annually. For a required rate of return of 6% on all investments find in how many years this investment will be paid off. Ratio of annual savings to investment = 2000 ÷ 10,000 = 0.200. Looking up intersection of 0.200 and 6% ordinates on chart find 6.2 years by interpolating between *dashed curves.*

This can be checked by finding the amortization rate = 0.200 − 0.060 = 0.140. Then at intersection of 0.140 and 6% ordinates on chart find 6.2 years by interpolating between *solid curves.*

By B G A Skrotzki

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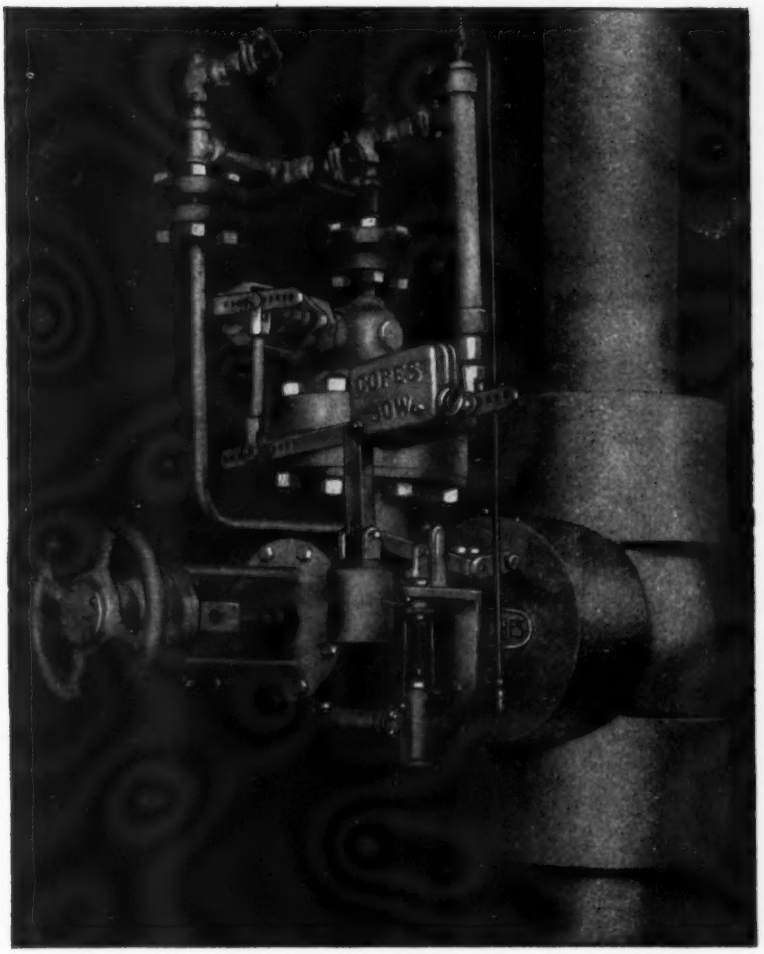


Vertical-line installation of a relay-operated COPES Flowmatic, one of the two duplicate units controlling water feed to, and water level in, a C-E boiler operating at 675 psi and with maximum capacity of 200,000 pounds of steam per hour.

Adaptable to any installation condition or operating preference

Whatever your space limitations, installation conditions or operating preferences, the COPES Flowmatic can meet them *exactly*. The basic design of this two-element boiler feed water regulator has been projected into a highly flexible system of feed control for utility or industrial boilers.

The Flowmatic Valve may be installed in either horizontal or vertical line. Direct or relay-operated, it may be strut-connected to the heavy-duty COPES Thermostat or arranged for remote control. The adaptations are almost limitless.

However your installation be made, close level control is assured by the "know how" of its designers. Write for Bulletin 429-A, which tells the COPES Flowmatic story. Your letterhead please.

NORTHERN EQUIPMENT COMPANY
261 GROVE DRIVE, ERIE, PENNSYLVANIA

Feed Water Regulators, Pump Governors, Differential Valves, Liquid Level Controls, Reducing Valves and Desuperheaters

BRANCH PLANTS: Canada, England, France
Representatives Everywhere

★ GET CLOSER LEVEL CONTROL WITH THE COPES FLOWMATIC ★ REGULATOR

FEEDS BOILER ACCORDING TO STEAM FLOW-AUTOMATICALLY

Roast Pork . . .

Just before Allied troops arrived in Utrecht, Holland, the Pegus power station was "protected" by German soldiers and watches were kept all over the place. But the chief engineer was also chief of the local underground forces and had a complete arsenal of weapons dropped by Allied planes.

As Allied troops neared the city, and while the Germans were waiting for instructions to destroy the station, the chief attacked with his own men. The attack was a complete success, but the captured Germans presented a problem. Finally he put them in the combustion chamber of a boiler not in use. It was an ideal prison, for the heavy cast-iron doors prevented any escape. An added argument in favor of quiet prisoners was the suggestion that any noise would result in a steam bath. The prisoners, according to reports, were very meek when the Allied troops let them out.

This and other similar stories weaken our frequent claim that ingenuity is an American (or a Yankee) characteristic. Apparently there are no national boundaries for this trait either. Faced with this fact, we're hard put to it to explain the development of ingenuity. Maybe it's a characteristic of anyone who works his way to the front—a major factor in helping a man to any job involving greater responsibility. Or maybe it's a trait that comes out only when necessary, an ability that is improved by necessity. We may not learn by experience, but we may have our wits sharpened by it.

In any case, the idea is interesting. Perhaps we should provide for people a series of ingenuity-building tests like those some scientists set up for rats or monkeys. It seems a crime to waste so much effort finding out how much lower animals know when we might make use of the same methods to make men keener.

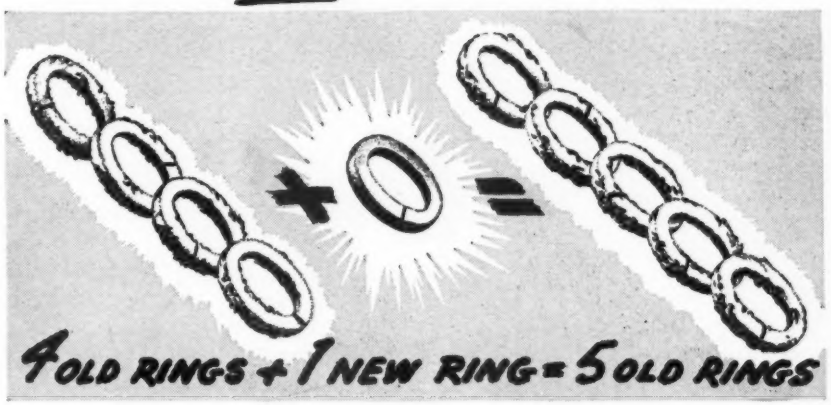
On the other hand, it may not be possible to build ingenuity by training, but it's worth trying. If a man must be on the brink of disaster to think his way out, we've got a modern case like the original Chinese method of roasting pork—by driving the pigs into a house and then burning the house down.

Some ingenious Chinaman figured his way out of that one. Or maybe he was a lazy Oriental who got tired of building a new house every time he wanted roast pork. Our present need is apparently for some lazy modern man who can force us to be mechanically—and socially—ingenious without burning our international house down every so often.

George Edwards
Engineer

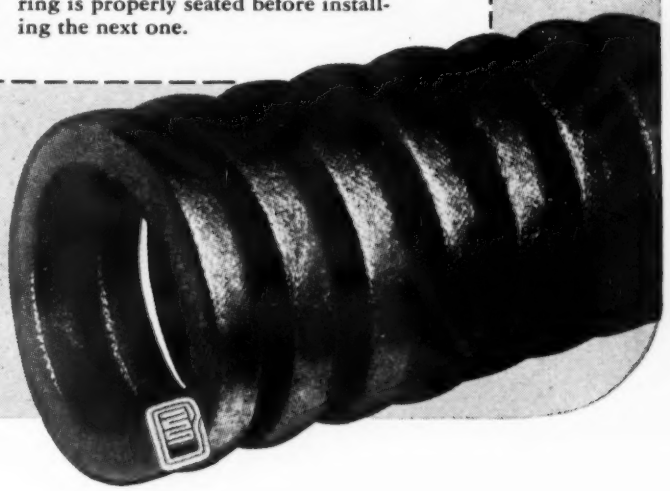
To get the most out of a repacking job...

1. REPLACE *All* OLD PACKING



Adding a new ring or two to the old packing in a stuffing box is like adding a quart of new oil to the old, worn-out oil in your car's crankcase. It doesn't do much good. To get a packing job that will *last*—and give proper protection against scoring, (1) remove all old rings, (2) clean out the stuffing box and (3) replace with all new packing. Finally, make sure each ring is properly seated before installing the next one.

2. CUT RINGS FROM J-M KEARSARGE ROD PACKING—



NO NEED TO WORRY about too-frequent repacking when you use Kearsarge! For here is one rod packing that won't *wear* out or *dry* out in a hurry.

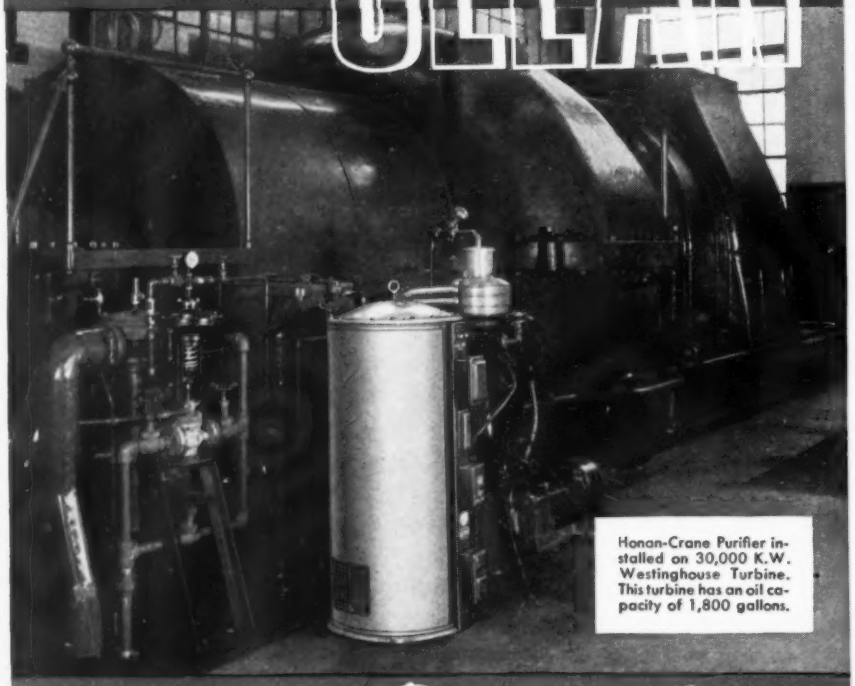
Designed for use against high pressure steam, Kearsarge retains its original pliability and resiliency even under continuous high temperature and high pressure service. The reason is found in its unique construction—an accordion-folded center block of asbestos cloth which forms a natural "reservoir" for the preserving lubricant and keeps the packing pliable. Additional resiliency is provided by a red rubber expansion back in the center block. Around this is a double wrapping of asbestos cloth to assure resistance to wear.

Kearsarge is one of many Johns-Manville specialized packings which are minimizing shutdowns and helping speed production in thousands of plants today. If you have a packing problem, write Johns-Manville, 22 East 40th Street, New York 16, New York.

Johns-Manville **PACKINGS & GASKETS**

THERE'S A DISTRIBUTOR NEAR YOU

GOVERNORS STAY CLEAN



Honan-Crane Purifier installed on 30,000 K.W. Westinghouse Turbine. This turbine has an oil capacity of 1,800 gallons.

on turbines *Protected* by
HONAN-CRANE OIL PURIFIERS

● Honan-Crane Purifiers, by removing sludge and sludge-forming acids from turbine oils, prevent deposits from forming in governor mechanisms. Keeping governors clean means greater turbine efficiency and less down time for governor repairs and cleaning.

Honan-Crane Purifiers keep turbine oil free from the most microscopic abrasives *and* troublesome acids that cause the oil to sludge and emulsify.

Honan-Crane Corporation, subsidiary of Houdaille-Hershey Corporation, is one of the world's leading manufacturers of oil purification equipment. Backed by extensive engineering and research facilities, Honan-Crane can give you the answer to any problem involving dirty or contaminated turbine or other industrial lubricating oils.

Write for engineering bulletins on the purification of Turbine and other industrial lubricating oils, and complete specifications on Honan-Crane Oil Purifiers.

HONAN-CRANE CORP.
1200 SIXTH STREET, LEBANON, INDIANA
Subsidiary of
HOUDAILLE-HERSHEY CORP.

Pumps Q & A

(*Continued from page* 116)

the pumps at heads below normal increases the load on the driver and sometimes causes an overload.

On the other hand a reduction in head on high-specific-speed pumps causes a reduction in power. An increase in operating head on these pumps causes an increase in power consumption and sometimes, may overload the driver.

Q 12—Can a centrifugal pump overload an electric motor?

A—Yes, if the pump horsepower increases with a change in capacity. It is thus dependent upon the shape of the pump power-characteristic curve and system-head characteristics.

Q 13—Can a centrifugal pump overload a steam turbine?

A—No, it cannot. With a fixed throttle position, a steam turbine develops a constant torque and the speed of the unit is always at a value where pump torque equals turbine torque. If the turbine is equipped with a constant-speed governor, a continued increase in torque causes the governor to open the throttle valve more and more until it is wide open. If pump torque exceeds turbine torque at set governor speed the unit slows down until pump torque equals that developed by the turbine. This is also true when the turbine is equipped with a constant- or excess-pressure regulator, the only difference being in the impulse that tends to maintain the required torque balance.

Q 14—What factors must be considered in selecting size of internal combustion engines to drive centrifugal pumps?

A—Sometimes internal-combustion engines are rated for the load they can carry continuously at rated speed, while others are rated for the load they can develop on test with full-open throttle. In the latter, power ratings may or may not include power required by the normally attached auxiliaries, such as circulating pump, fan, etc. Engines of the automotive type are generally rated for their maximum developed power on dynamometer test while stripped of all auxiliaries. Such engines usually operate safely with a continuous loading of only 75 to 80% of their developed power.

Most automotive engines are high speed and have a short life when run continuously. There are available medium-speed engines that have a longer life and low-speed ones that have a long life with minimum maintenance.

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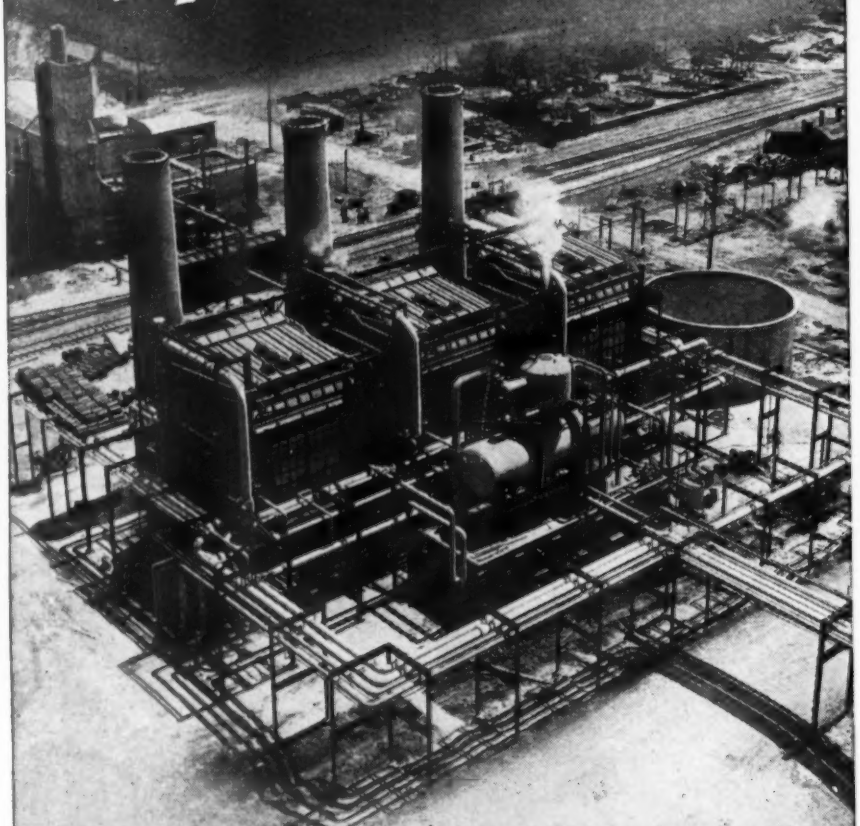

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which are rated on the basis of load they will carry constantly, will also carry an overload. Engines rated on maximum developed power can be operated loaded to more than 75 to 80% of their developed power. But if other than momentary, this will generally result in mechanical failure. The engine best suited for any particular application must therefore be selected with consideration to service requirements.

Q 15—Does the variation in operating conditions affect the driver selection?

A—When centrifugal pumps operate under variable head or discharge, or both, drivers that permit economical speed variation are preferred. Choice of drivers suitable to variable-speed operation is quite wide: steam turbines, internal-combustion engines, wound-rotor ac motors and sometimes dc motors. Synchronous or squirrel-cage motors are also used with a variable-speed transmission, such as a hydraulic or magnetic drive.

Q 16—Is variable-speed drive always more economical than constant-speed drive when operating conditions are variable?

A—No, it is not. Many factors enter into the evaluation of the most economical operating method under such conditions. While considerable horsepower may be saved in varying the speed of a steam turbine or of an engine, efficiencies of slipring motors and hydraulic and magnetic transmissions are practically proportional to their operating speed. Power saving, if any, must be considered along with the increased cost of the drive over a constant-speed drive. In some applications such as boiler feed service, power losses due to throttling the pump discharge are converted into heat that is returned to the boiler and must be taken into account in any evaluation of variable- and constant-speed drives.

Q 17—What is a dual-driven pump?

A—It is a pump arranged so that it can be driven by either of two drivers, Fig. 2. Generally the two are different, one for regular service, such as an electric motor and the other say, a gasoline engine for use when power to the motor fails.

Q 18—How are dual drives usually arranged?

A—One driver is generally connected to each end of the pump, so the one not being used can be disconnected. This arrangement requires a double-extended pump shaft and end-suction pumps cannot be used. Also, pump selection is often compromised to suit the available drive speed.

Q 19—Can two drivers be used on one

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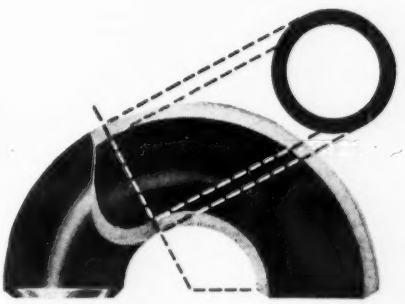

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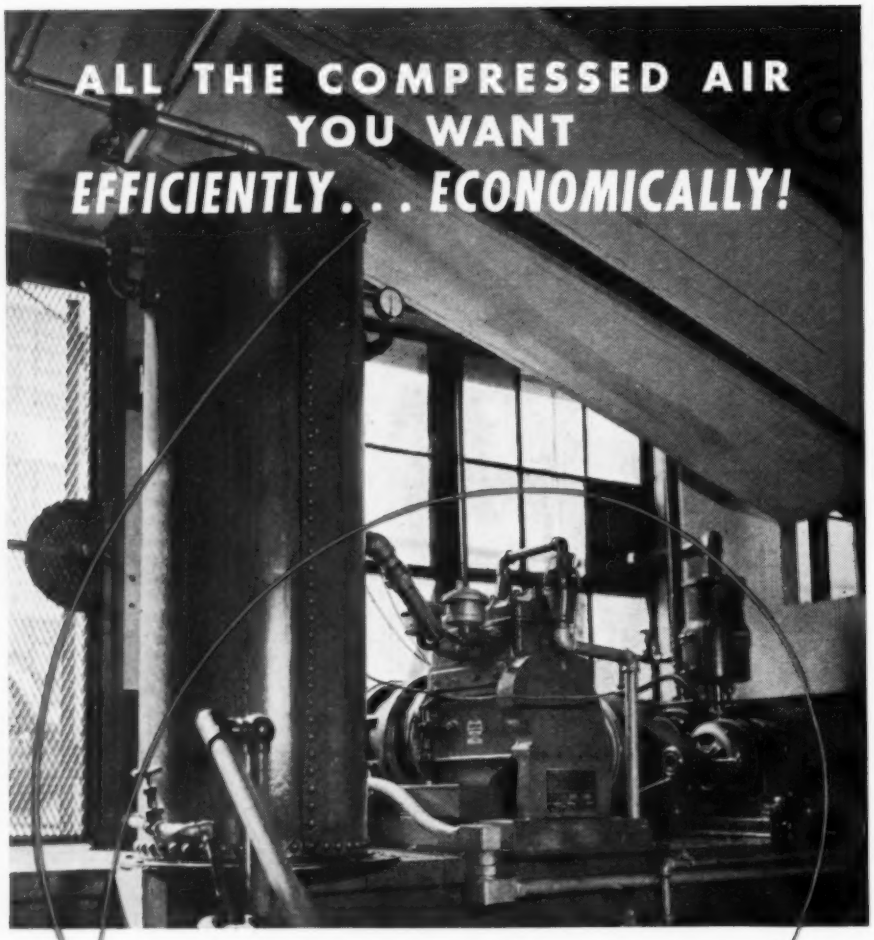

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centrifugal pump, each taking part of the load?

A—Yes, in a few installations the pump is driven by two power units each carrying part of the load. The commonest installations of this kind combine an electric motor and a water or steam turbine. For such an application, a water turbine without a governor is used. Where the other power unit is an induction motor, pump speed varies slightly with changes in operating conditions to maintain a balance in which power developed by the two drivers equals that needed by pump.

Reader's Problems

(*Continued from page* 113)

Reduce Time Lag by Fixed and Variable Control

INSTALLATION in Dec Q-1 sketch shows all six heaters arranged in parallel and controlled by a single contactor. Because of time lag in the heating elements *MCC* states his oil-temperature variations exceed specifications. Effect of this time lag can be reduced by using a fixed and variable control. In this type installation, sufficient heaters to maintain oil temperature slightly below minimum specified value are energized at all times. The remaining heaters are operated from the thermostat. In this way fluctuations are reduced by the presence of the constant heater source.

Washington, D. C. ROBERT M HAAG

Use Manual Switch For Four Heaters

THE DIFFICULTY is due to having all heating capacity controlled by one thermostat. When oil of the required temperature reaches the thermostat bulb the heaters are cut off completely. Then cold oil rises from the bottom, and by the time it reaches the bulb to turn the power on again a considerable amount has already passed the heaters. It is impossible to raise the temperature of this portion before it leaves the heater.

Lower four of the six heaters should be controlled by individual manually operated switches. This method turns on sufficient heating capacity to heat the oil to a point that is less than the desired temperature. The thermostatically controlled bank then controls the oil temperature by the rest of the heaters.

For safety the power to the manually controlled bank of heaters should pass through some protective device to prevent them being turned on when oil is

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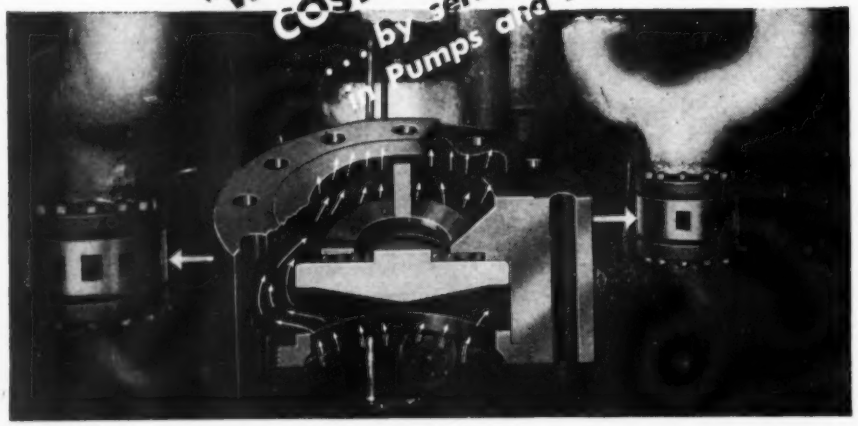

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not circulating. A switch interlocked with the pump motor control would be satisfactory. A better safeguard would be a switch controlled by a second thermostat, which could be set at, say 220 F, and which would normally act only as a safety device.

Hamilton, Ont. D H MATHESON

Move Thermostat Bulb To Center of Oil Heater

MCC's DIFFICULTY is undoubtedly caused by the fact that the thermostat is located at the extreme outlet of the oil heater. Therefore when the outlet temperature becomes low enough to cut the heater in service the heater itself is full of cold oil, which passes on to the centrifuge before it is heated. The reverse is true when the outlet temperature becomes high enough for the heater to cut off. The heater is full of hot oil, which absorbs still more heat before it reaches the centrifuge.

MCC can correct his trouble in several ways, some of which are listed below: (1) Several of the heater elements (exact number to be determined by trial) can be connected direct so as to be in service at all times, the remaining elements being controlled by the thermostat. This arrangement would greatly minimize the cyclic effect of the thermostat. (2) Thermostat can be moved from the heater outlet to a point nearer center. This should improve conditions since it will, in effect, allow the thermostat to anticipate the outlet temperature of the oil. This will compensate the time lag in the heaters as a result of the cooling and heating cycles. Operating range of the thermostat will have to be found by trial, which will give the desired oil outlet temperature. (3) If methods 1 or 2 do not correct *MCC*'s trouble he can go a step farther, purchasing an additional thermostat and relay, and operate half the coils off of one and the other half off the other. One temperature element should be located near the outlet and the other near the center of the heater.

Better operation can always be obtained with a thermostat having a range of operation less than 20 F. There are several makes on the market that operate in a 5-deg-F range.

Baton Rouge, La. J T THOMAS

Answers to Dec. Question 2

(*Continued from page* 114)

bell and battery test set check between sliprings and you should get a closed circuit between any two rings. If you do not, check the wires leading from collector rings to resistors. This is one source of trouble with this type of motor. Check

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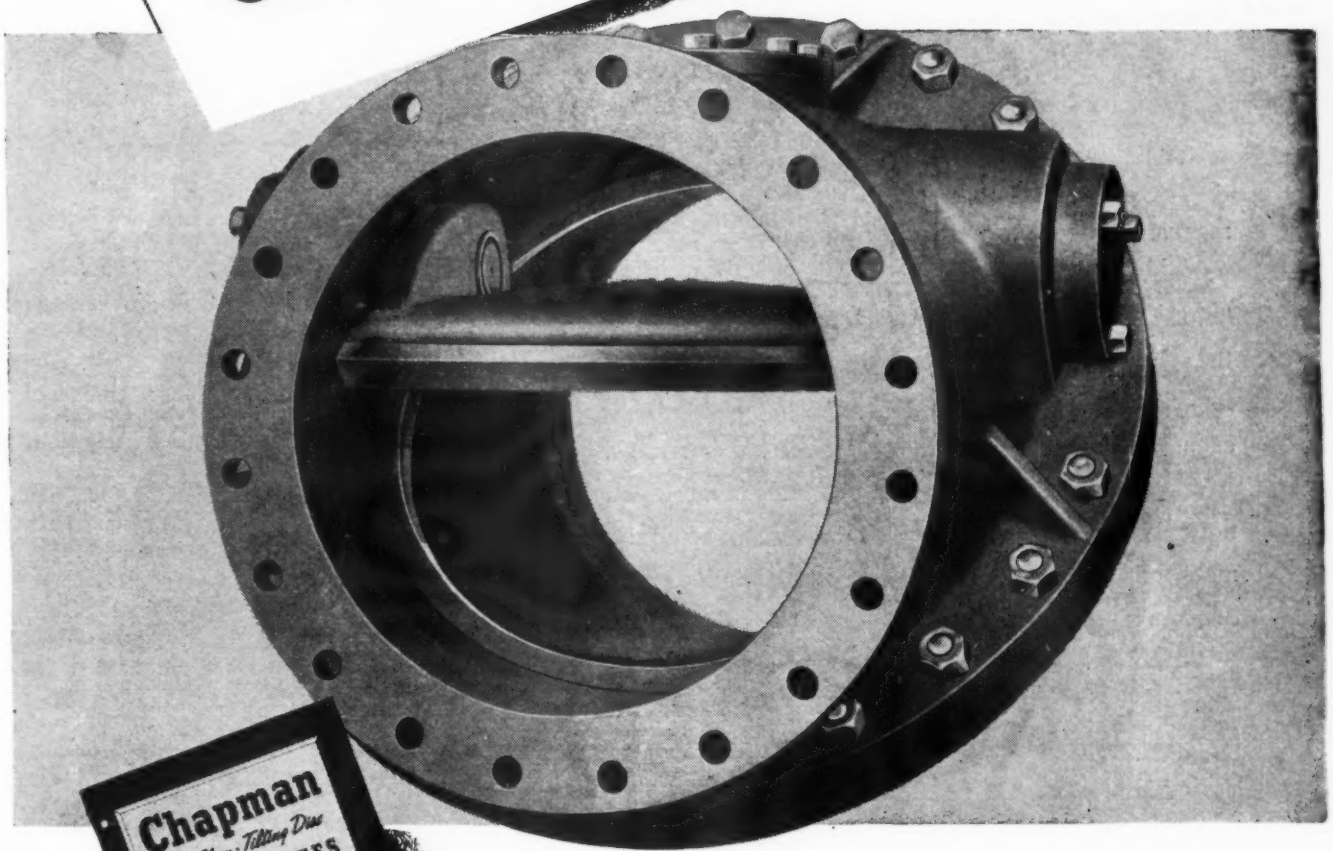

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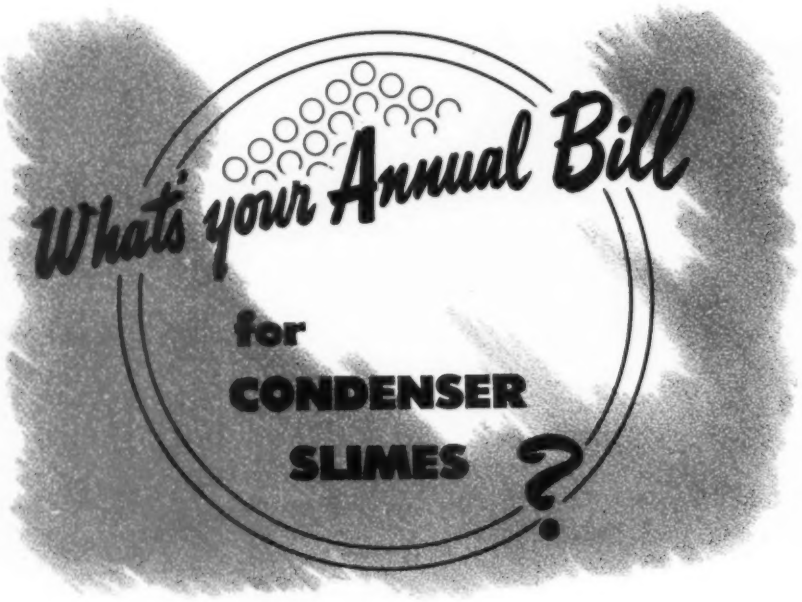

● If you are cleaning condensers by mechanical means, have you figured just how much it is costing you annually? When you do, be sure to include all the "hidden costs" in reduced production – *not only* in time lost when condensers are "off the line", but for all periods when they are not operating at rated capacity, due to slime impaired heat transfer rates.

When you utilize chlorination for slime control, you not only cut out time losses from shutdown of equipment, but you also get rated capacity from your condensers *all the time*.

If deposits already are present on the water-side surfaces of condensers, chlorination removes them, and then, by destroying the slime organisms in the water supply, it prevents the formation of further slime coatings.

To secure the most effective results from chlorination at minimum cost, the method of application and type of chlorinating equipment should be adapted to the individual requirements of your plant. W&T engineers will gladly make recommendations based on an actual survey of your requirements.

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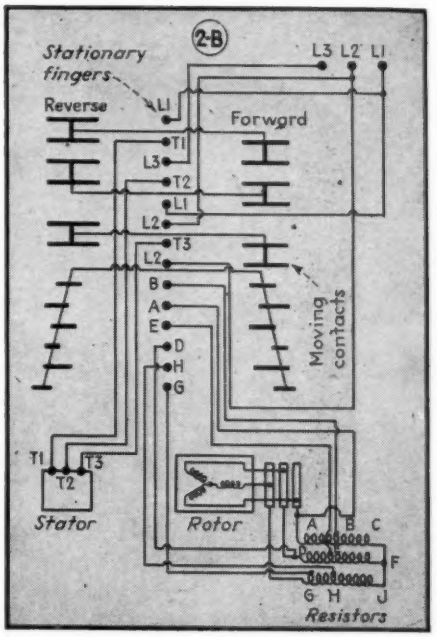


wire from brush holder to *A* on resistors, also from *D* and *G* on resistors to each individual brush holder.

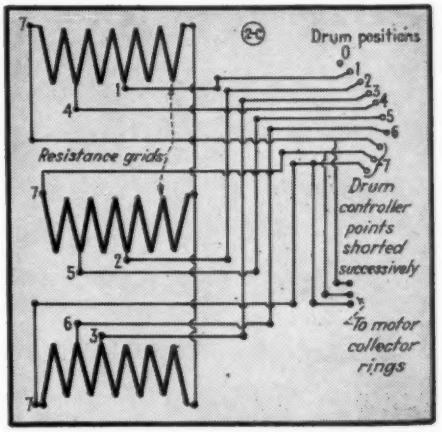
After this has been done check individual wires between *A D G* on controller and *A D G* on resistors. Another source of trouble sometimes occurs when renewing segments on controller. If a short segment is placed opposite *A D G* on controller it will not be completely short circuited and will cause a slow down of rotor in the last position.

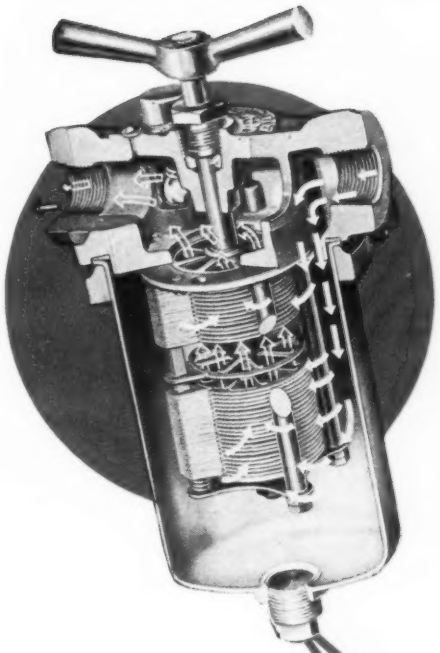
Detroit, Mich. P FREEMAN

Examine Drum Controller Contacts and Fingers

WHEN TSD's DRUM CONTROLLER is in the last notch and is supposed to short circuit the rotor resistance, I believe it cuts in additional resistance instead. *TSD* states that he has gone over the entire electrical system but found no electrical defects. However I am of the opinion that there is an incorrect connection in the contacts of the controller.

Sketch 2-C shows contacts, wiring con-





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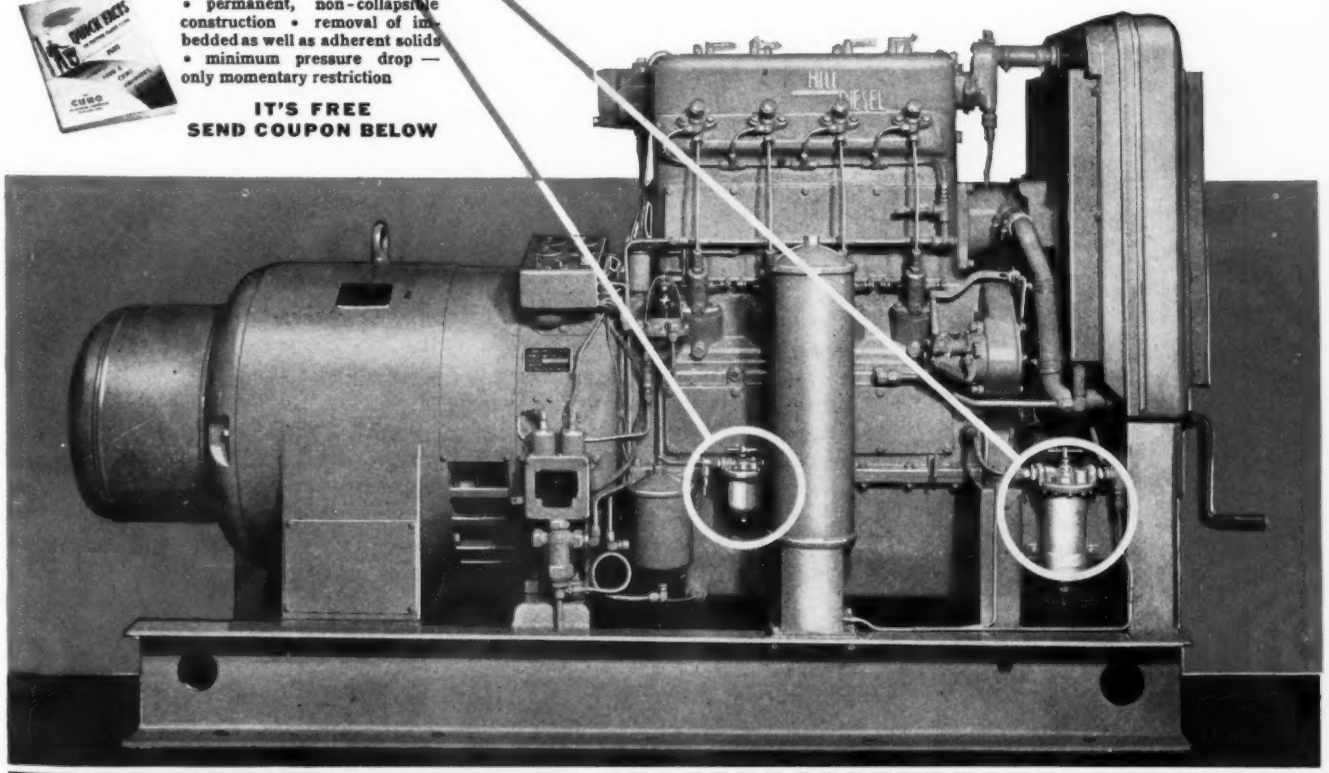

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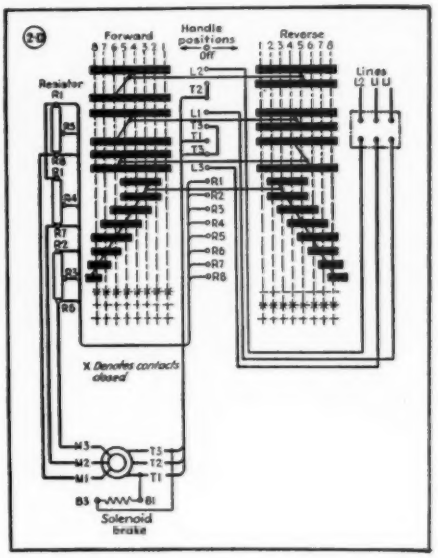
nections and external resistance for the type of equipment used by *TSD*. If the last three connections were shorted in the controller when the handle was placed on the last position it would tend to cut-out resistance. Moving the controller handle in the reverse direction should break this connection, cut-in resistance and change the motor speed.

I suggest *TSD* examine the drum controller for poor connections, bare wires, worn parts and other faults that could cause this condition.

Duluth, Minn. E R WEBBER



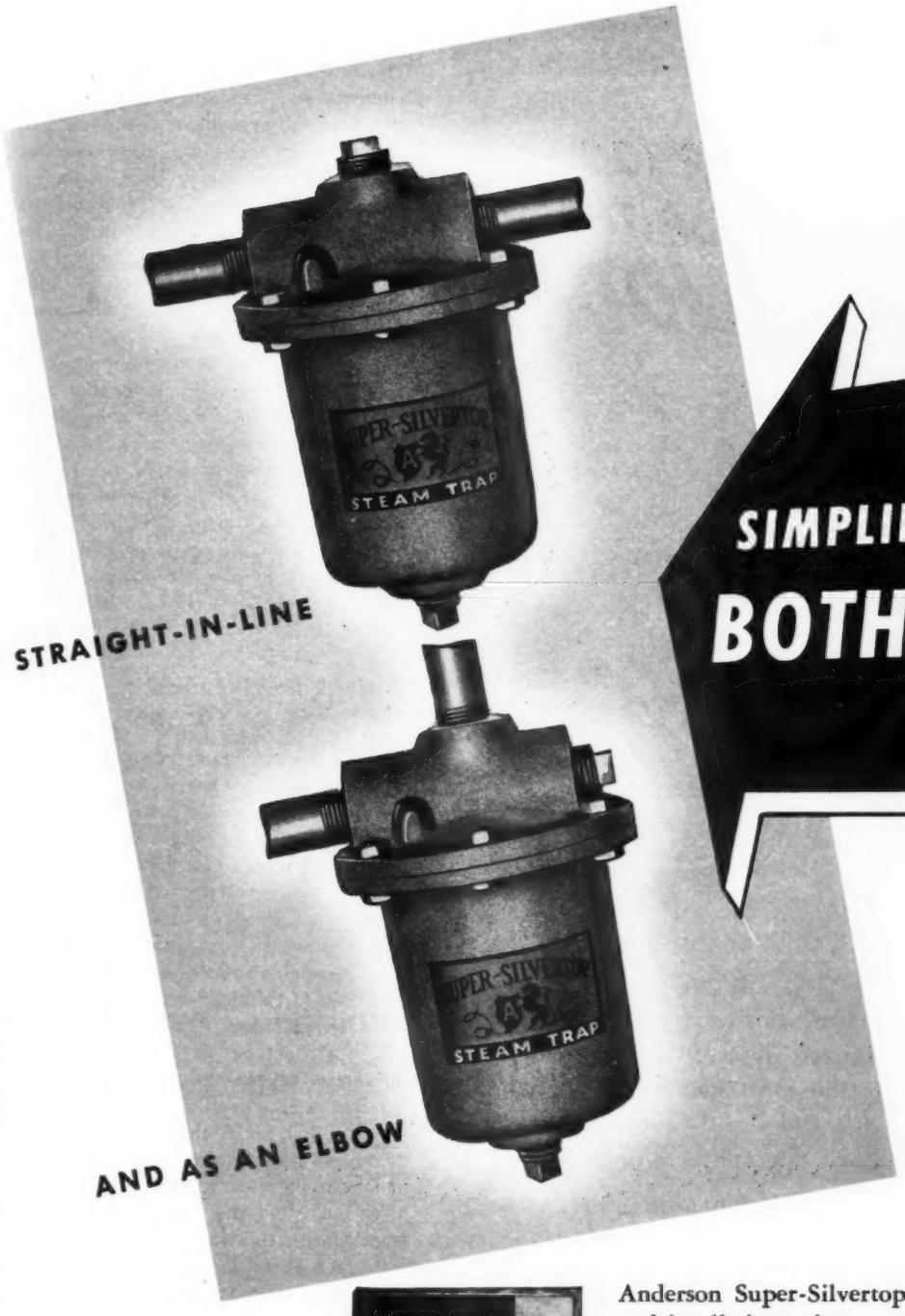
Check Short Circuit Connections to Sliprings

A WOUND-ROTOR MOTOR decreases its speed (1) if frequency of the circuit decreases (2) load increases (3) resistance in the secondary circuit increases. Since this decrease in speed occurs only when the controller is advanced from the next-to-the-last to the last point, it is quite evident that this operation of the controller inserts more resistance instead of short-circuiting the sliprings of the motor as it should.

In sketch 2-D, the last point of the controller short circuits the motor slip-rings and should cause the motor to accelerate to its maximum speed. I suggest that *TSD* check the connections between the resistor and the controller, particularly lines *R6*, *R7* and *R8* of the sketch. He should also check lines from the rings *M1 to R8*, *M2* to *R7* and *M3* to *R6* to be sure they go to the correct terminals on the resistor.—*RFE*

Speed Check Should Help To Locate Motor Trouble

TSD's PROBLEM, in which a slipring motor slows down when the controller is moved to the final position, indicates that



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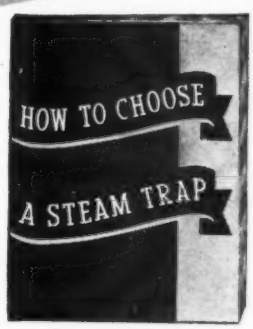

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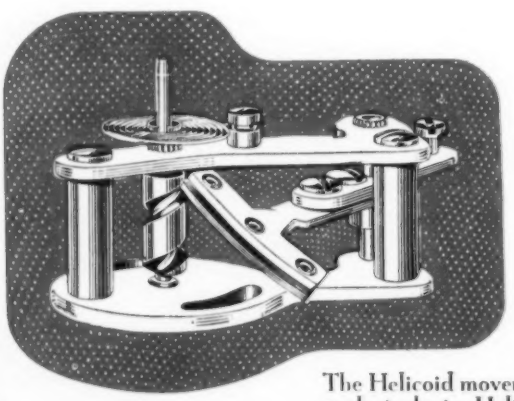

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resistance is being cut into the circuit by moving the controller to the final or high speed notch. *TSD* has made sure that all contacts and fingers are clean and that his electrical system for the motor is not at fault. I suggest he also make sure that (1) the spring tension on the contact fingers is sufficient to secure firm contact with the controller in the final position (2) there is no mechanical fault in the drum controller which is cutting in resistance when the controller arm is in the final position.

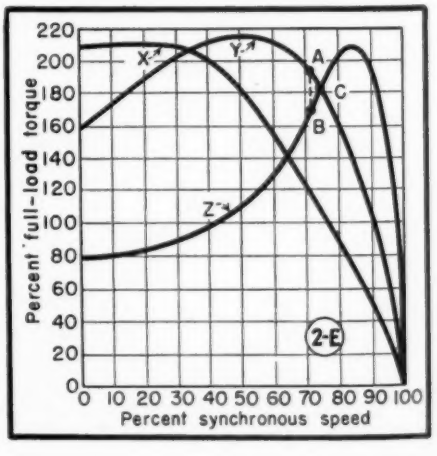
A speed check of the motor for the various positions of the controller might also assist in locating the difficulty. It is possible, because of mechanical fault in the controller, that the speed of the motor in the final position of the controller coincides with the speed at one of the intermediate positions. This check would serve to indicate the location of the trouble and its consequent solution.

New Orleans, La. W R KILBOURN

Adjust Resistance To Increase Torque

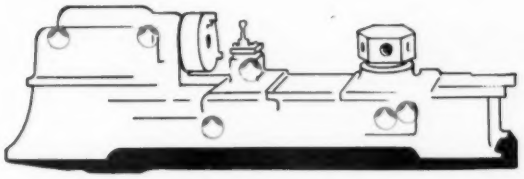
[EDITOR'S NOTE: *The following solution, prepared by the* POWER *staff for TSD's consideration, approaches the problem from a somewhat different angle than the answers printed above:*]

IF TSD WOULD CHECK THE LOAD on his hoist when it slows down in the last notch he would probably find it higher than normal. Speed and torque corresponding to this load are represented by point *A* on curve *Y* in sketch 2-E. In this sketch curve *X* is motor speed-torque curve for the second from last notch of the controller, curve *Y* for next to last notch, and *Z* the curve for the last notch, or short-circuited rotor. If the motor accelerates to point *A* under a given load and the controller is shifted from the next to last, to last notch the shift is vertically downward to point *B* on the curves because speed remains constant at instant of shift. Since *B* provides less torque than *A* at the common

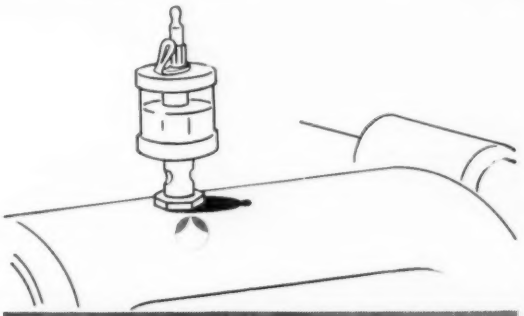


CODED LUBRICATION

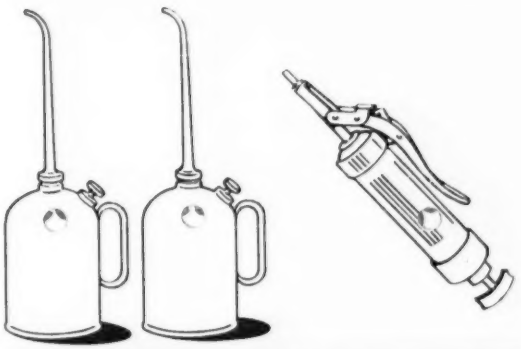
tells your oilers 4 important facts... with simple numbers



1. Where lubricant is needed



2. Which lubricant to use



3. Which oil can or grease gun to use

4. Which lubricant is in each storage container

TROUBLED with getting the right lubricants in the right places? Standard's Coded Lubrication Service can help you. And it's easy to install and simple to follow.

Code numbers, not colors, are assigned to each lubricant used in your plant. Numbered decals are applied at each point to be lubricated, indicating which lubricant is to be applied. Every grease gun, oil can and storage container is numbered to indicate what lubricants are in them. Your oilers simply follow the numbers without having to remember brand names and grades.

A Standard Oil Lubrication Engineer will be glad to discuss the application of Coded Lubrication in your plant. Call the nearest local Standard Oil office or write 910 South Michigan Avenue, Chicago 80, Illinois, for the Engineer nearest you.

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

Class	Type	Kind of Soap	Upper Temp Limit	Characteristics
Lime Soap (Calcium)	Cup	Lime fat	175° F.*	Smooth, water resistant, separates on boiling out water content, limited consistency loss on working.
	Axle	Lime rosin	150° F.	Smooth, sticky, water resistant, separates on boiling out water content, great consistency loss on working.
Soda Soap	Fibre and Sponge	Soda fat	375° F.	Fibrous, not water resistant, does not separate at elevated temperatures, variable consistency loss on working.
	Medium and Short Fibre	Soda fat	375° F.	Semi-smooth, not water resistant, does not separate at elevated temperatures, variable consistency loss on working.
	Smooth (block, brick)	Soda fat (variable soda rosin content)	400° F.	Smooth, hard, not water resistant, does not separate at elevated temperatures.
Aluminum Soap	— — —	Aluminum fat	240° F. (average)	Smooth, gel-like or stringy, water resistant, becomes fluid at elevated temperatures, limited consistency loss on working.
Compounds	Residuum	Usually none	— —	Smooth, black, adhesive, excellent pressure and water resistant.

*As high as 200° F. for special lime soap greases where such maximum temperature is intermittent.

To get longer life from bearings

(1) Use the right grease

The difficulties of choosing the right type of grease for any particular application are demonstrated in the table above. This lists the general operating characteristics of the more common types of grease. In addition, each type comes in many grades and all have advantages for specific grease lubricating jobs.

Many plant men have given up trying to guess their way through this maze. They know that Standard Oil makes all types of grease. They've found that Standard Oil Lubrication Engineers are qualified by training and experience to analyze operating conditions and fit the right type and grade of grease to the job. But the right grease is only half the problem. The other is:

(2) Good Maintenance Practices

The proper functioning of even the best grease in a bearing depends upon many factors such as condition of seals, bearing alignment and lubricant application, to name a few. A common tendency, for example, is to apply too much grease to anti-friction bearings. This results in excessive churning of the grease, undue friction and leakage.

Here again a Standard Oil Lubrication Engineer can help you by determining the cause of bearing or lubricating failures. Put your lubricating problems into the hands of one of these Lubrication Engineers. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Ill., for the Engineer nearest you.

STANDARD OIL COMPANY (INDIANA)

STANDARD SERVICE

NO "GLAND TROUBLE"

Because UNITROL level Controller has no packing glands or stuffing box

On recirculator systems of condenser hotwells, deaerators—or wherever the level of liquids must be controlled—UNITROL will do it more accurately! Simple . . . self-contained . . . this exclusive design eliminates trouble-making restrictive elements. Friction is minimized. Action is free and unhampered. Feed or drain is regulated promptly and positively. The float is linked to the inner valve through ratio connection, with maximum float travel on any size valve of only 7 inches. Available for temperatures up to 750° F.—in valve sizes ½" to 4"—integral casting construction—valve and float-cage of semi-steel or cast steel—float of seamless copper or stainless steel—and with the fine craftsmanship for which K & M has been recognized for 75 years. Our Engineering Department will be glad to make specific recommendations.

Write for Catalog 66-C

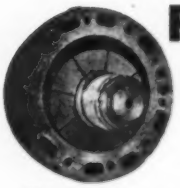
KIELEY & MUELLER, INC.
MANUFACTURERS OF PRESSURE AND LEVEL CONTROLS
2001 - 43RD ST., NORTH BERGEN, N. J.

Awarded our employees for outstanding production achievement

HERE'S WHAT YOU GET WITH A FULLER ROTARY

DIRECT DRIVE
ACCESSIBILITY
LOW MAINTENANCE
SIMPLE FOUNDATIONS
BLADES AUTOMATICALLY COMPENSATE FOR WEAR
SMALL FLOOR SPACE WITH RELATION TO CAPACITY
MAINTAINED CAPACITY FOR THE LIFE OF THE MACHINE
UNNECESSARY BULK ELIMINATED
NO BEARING TAKE-UP
NO LEAKING VALVES OR GRINDING OF SEATS
NO AIR-LINE PULSATIONS
NO MULTIPLICITY OF PARTS REQUIRING FREQUENT ATTENTION, ADJUSTMENT AND REPLACEMENT

SIMPLE DESIGN... RUGGED CONSTRUCTION... EFFICIENT PERFORMANCE



For many years Fuller engineers have striven to build the best compressor money could buy . . . simple in design, easy to operate, ruggedly constructed for long, continuous service at minimum expense. With these thoughts uppermost in mind, it's natural that only the best of materials and workmanship go into the makeup of Fuller Rotaries. Also designed so that when repairs and inspection do become necessary, the work can be accomplished with the least possible effort and minimum loss of time.

This continued effort has paid dividends, as is shown by the hundreds of machines in daily operation and the many repeat orders from satisfied users.

Before purchasing your next compressor it will pay you to consider the outstanding features of these really efficient machines. Let us send you Bulletin C-5. It's yours for the asking.

FULLER COMPANY
CATASAUQUA, PENNSYLVANIA
Chicago 3 - 1144 Marquette Bldg.
San Francisco 4 - 421 Chancery Bldg.
Washington 5, D. C. - 618 Colorado Bldg.

C-136

FULLER
PIONEERS OF HIGH-EFFICIENCY ROTARY COMPRESSORS

speed the motor slows down unless the load is small enough for the motor to accelerate along curve *Z* from point *B*. On other occasions when *TSD's* motor continues to speed up after the controller is shifted into the last notch it is an indication that point *C* has been reached or passed on curve *Y*. After this point is reached curve *Z* produces more torque than *Y* and motor speeds up in the last notch.

TSD's trouble can be eliminated by reducing either the load or the secondary resistance in the next to last notch. Reducing the resistance has the effect of lowering curve *Y* and a point should be easily reached somewhere between *B* and *C* on curve *Z* by the cut and try method where his hoist continues to accelerate at the loads he wants to carry. He must bear in mind however that a wound rotor induction motor generally produces maximum mechanical power output at a speed higher than that at which it produces maximum torque. Therefore his motor can accelerate a load up to the maximum-torque speed point but cannot accelerate it to full-load speed or maximum horsepower output point.

Valves, Seats and Guides

(*Continued from page* 90)

cages, it may prove preferable to grind seats after installing cage in cylinder head. This eliminates inaccuracies caused by distortion which may occur between seat and guide if hold-down bolts are adjusted unevenly.

Many operators experience considerable difficulty in removing press-in seat inserts. Although no cure-all for such difficulties can be offered, the method outlined here proves effective for removing inserts with a relief or bevel on the lower inside edge. This requires a piece of hardened square steel of proper size cut off to a length just slightly above that of the inside of the insert, Fig. 4. Bevel this piece on each end at 45 deg, to almost a sharp edge. Insert it under the seat at the chamfer or relief and place against it a round bar that will go through the valve-guide hole. Hammer to knock the seat out. Rotate the tool slightly after each blow to prevent any chance of cocking or tipping the seat in the counterbore. Special adjustable valve-seat-removing tools are available. These operate on the toggle-joint principle and readily force out seats having chamfer on the lower inside edge. Reversible gear pullers may also be used.

Next in importance to the valve and

HOODOO SMASHERS!

America's newest and widest line of V-Belts — Allis-Chalmers' Texrope — solves problems that have hoodooed drives in almost every industry . . . see what they can do for you!

I ROUT THAT OLD BUGABOO, STATIC ELECTRICITY. I'M STATIC-RESISTING SUPER-7. MY BUILT-IN CONDUCTING ELEMENT CARRIES CHARGES TO THE MACHINE WHERE THEY'RE GROUNDED.

A-C

Texrope V-belts are available nation-wide through Allis-Chalmers Dealers and Sales Offices

IT PAYS TO MAKE

ALLIS-CHALMERS

YOUR V-BELT DRIVE HEADQUARTERS

Texrope Super-7 V-Belts result from the cooperative research of two great companies — Allis-Chalmers and B. F. Goodrich — and are sold exclusively by A-C.

BULLETIN!

SPEED RECONVERSION WITH HELP OF NEW FREE A-C KIT!

Guide to "How to Take Reconversion Inventory" of Drives, Motors, Pumps

Help in the big job of reconverting for peacetime production is now offered to plants everywhere by Allis-Chalmers Mfg. Co., its district offices and distributors. To all who request it, we're sending the new "Reconversion Inventory Kit", planned to speed the task of determining the condition of your existing equipment — V-belt drives, motors, and centrifugal pumps — which will be used in reconverted production.

SUGGESTS PROCEDURE, STATES STANDARDS

Used by foremen, maintenance men, and engineers, the Kit is a real time-saver . . . leads efficiently to probable trouble spots, helps clear them up. Gives bearing tolerances, resistance formulae, etc., in compact, easily-used form. Check List appraisal charts help determine present and future condition of units inventoried.

HOW TO GET YOUR KIT

For your free Reconversion Inventory Kit, call your nearest Allis-Chalmers distributor or district office, or write Dept. 16, ALLIS-CHALMERS MFG. CO., Milwaukee 1, Wis.

A-1910

ALLIS-CHALMERS MFG. CO.
Dept. 16, Milwaukee 1, Wis.

Please send Reconversion Inventory Kit free of charge to:

Company.....

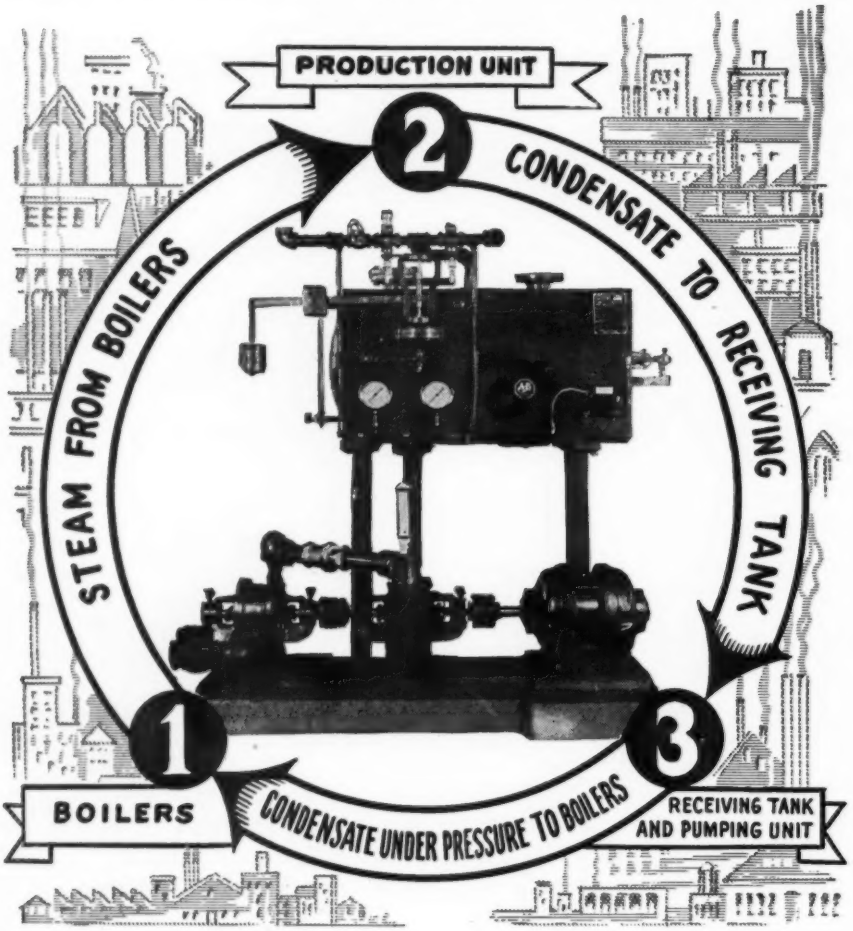
Address.....

.....

Attn. of Mr.....

INCREASED PRODUCTION —DECREASED COSTS

For Industries Using Process Steam



The use of Stickle Differential Drainage and Boiler Return—a closed pumping system—reduces fuel costs up to 20 per cent. Returns condensate from processing units to boilers, under pressure, at temperature only 15 to 20 degrees lower than steam at operating pressure. Boiler capacity is increased in ratio to fuel saving, affording greater steam supply. This combined with complete and positive drainage permits production units to function at maximum capacity. Maintenance cost for steam lines, valves, traps and boiler is reduced by elimination of high velocities and reduction of boiler scale.

After a year's experience, leading New Jersey food packer says, "Fuel bill about one-third of last year and fully fifty per cent of saving due to Stickle System." Several hundred installations in plants using steam for drying, cooking and other processing operations, giving gratifying results.

Advantages Stickle System will obtain under given operating conditions predetermined and guaranteed for installation. Information without obligation. Ask for Bulletin No. 250.

OTHER EQUIPMENT: Stickle Open Float Steam Traps; Stickle Regulating and Reducing Valves; Stickle Temperature Control Valves; Stickle Open Coil Feed Water Heaters; Stickle Triplex Oil and Steam Separators.

STICKLE STEAM SPECIALTIES COMPANY

2265 VALLEY AVENUE, INDIANAPOLIS 1, INDIANA

SPECIALIZING FOR MORE THAN 40 YEARS IN REDUCING THE COST OF STEAM

seat in the mechanism of an engine comes the guide. Perhaps too little significance has been attached to the role this part plays. Proper clearance between guide and stem and alignment with the valve seat have been emphasized. Let's deal briefly with installation.

Installing Valve Guides

First check the guide bore in the cylinder head, block or cage to see if it has become worn. Then measure the fit diameter of the guide to determine if it has the proper interference fit in the bore. A safe rule allows 0.001 in. of fit for each inch of fit diameter of the guide. For example, a guide having a fit diameter of 2 in. should show 0.002 in. press fit. Avoid installing guides with too great an allowance for press fit, as there is danger of breaking the guide or of distorting the bore in the guide itself, which may cause valve sticking.

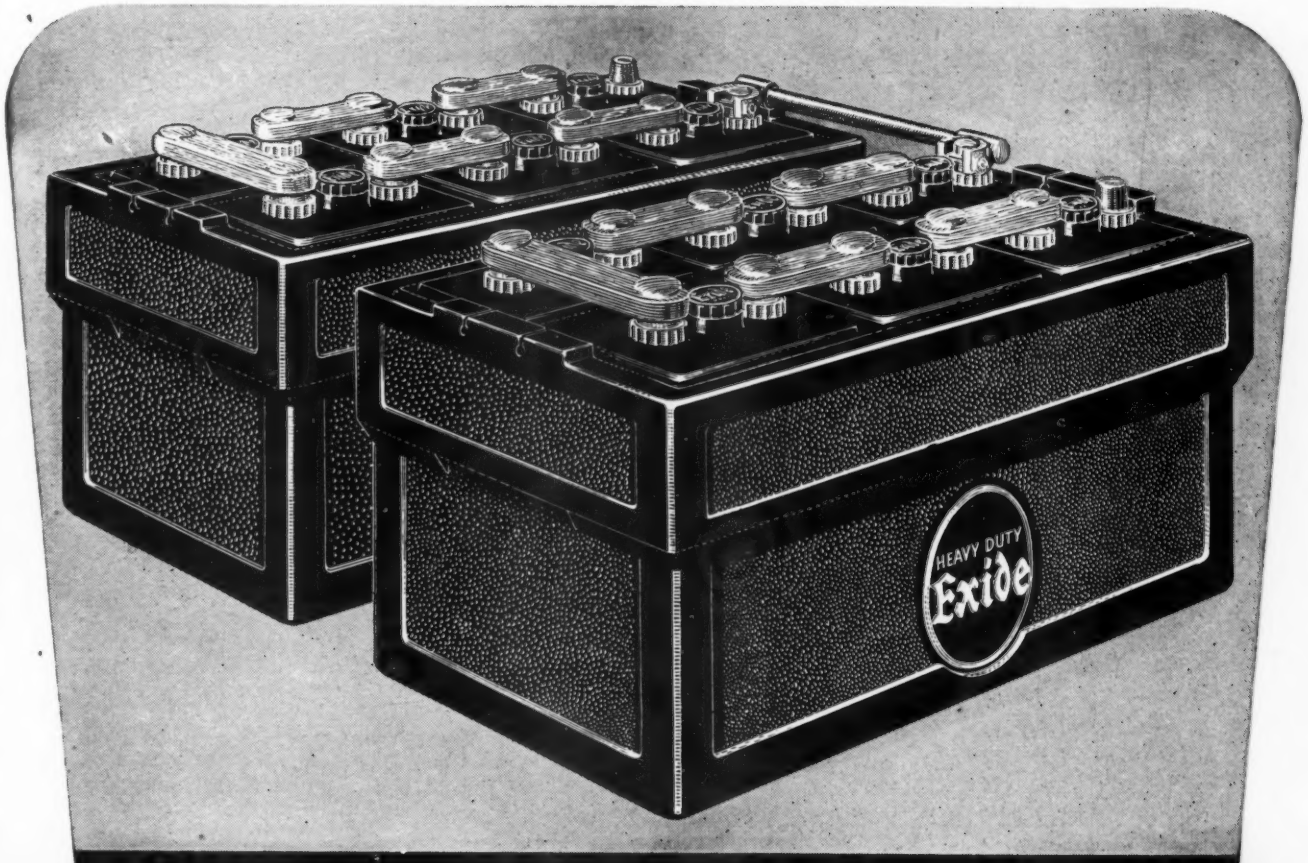
It is desirable for the guide to extend well up toward the valve head, but it is important to avoid having a thin-wall section extending unprotected into the open exhaust flame. If this is done, the thin section tends to curl as the exhaust flame sweeps across it, causing valve sticking and leakage. Replacing worn guides or bushings at regular intervals proves a good investment in engine operating efficiency. Guides should never be operated with clearances of more than twice that originally allowed on new parts.

Some engines with cages do not have removable valve guides. However, in most cases it is no big problem to bore these out to accommodate a bushing having a wall thickness of from ⅛ to ¼ in. Be sure to bore out the cage to size for its full length and from the same end. On unusually long cages it proves desirable to install two bushings with a total length somewhat less than cage length. Press one bushing in from each end, leaving a space between the two in the center for an oil pocket. This method lessens the chance of valve sticking in the guide from cage distortion.

Pressing-in Guides

Preferably, guides or bushings should be pressed in or out with a hydraulic or screw press. If neither is available, the job can be done by driving. Make a driving tool from a round steel bar slightly smaller than the outside diameter of the guide or bushing. A portion of the bar, say ½ to 1 in., is machined to a diameter slightly under the guide hole. Undercut the shoulder slightly so that it will ride on the outer edge of the guide. Insert the tool in the guide hole, Fig. 5, and drive the guide into place.

An article to follow will discuss lubrication, valve springs and valve timing.



EXIDE BATTERIES PUT EXTRA POWER IN DIESEL ENGINE CRANKING

The outstanding success of Exides in this exacting service is due to Exide engineering and manufacturing skill, and to Exide understanding of Diesel cranking needs. These have resulted in the development of a battery specifically designed for Diesel engine cranking . . . a battery that is noted for dependability, long-life and ease of maintenance.

Write for FREE copy of the Exide Catalog on Heavy-Duty Batteries. It gives you catalog data and information on how to get the most from your Diesel cranking batteries.

Exide
BATTERIES
FOR CRANKING
DIESEL ENGINES

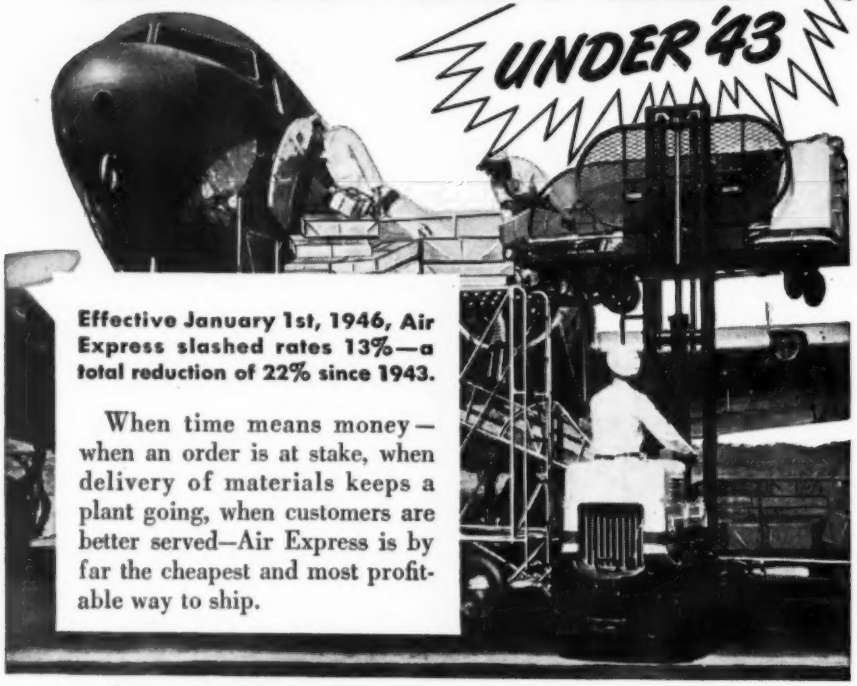
THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia 32 • Exide Batteries of Canada, Limited, Toronto

SAVE TIME MAKE MONEY

SHIP by AIR EXPRESS

RATES CUT 22%

UNDER '43



Effective January 1st, 1946, Air Express slashed rates 13%—a total reduction of 22% since 1943.

When time means money—when an order is at stake, when delivery of materials keeps a plant going, when customers are better served—Air Express is by far the cheapest and most profitable way to ship.

Specify Air Express-a Good Business Buy

Shipments travel at a speed of three miles a minute between principal U. S. towns and cities, with cost including special pick-up and delivery. Same-day delivery between many airport towns and cities. Rapid air-rail service to and from 23,000 off-airline points in the United States. Service direct by air to and from scores of foreign countries in planes made in America, operated by American personnel and flying the U. S. flag.

HERE'S HOW LITTLE IT COSTS (U. S. A.)					
AIR MILES	2 lbs.	5 lbs.	25 lbs.	40 lbs.	Over 40 lbs. Cents per lb.
149	$1.00	$1.00	$1.00	$1.23	3.07
349	1.02	1.18	2.30	3.68	9.21
549	1.07	1.42	3.84	6.14	15.35
1049	1.17	1.98	7.68	12.28	30.70
2349	1.45	3.53	17.65	28.24	70.61
Over 2350	1.47	3.68	18.42	29.47	73.68

AIR EXPRESS

GETS THERE FIRST

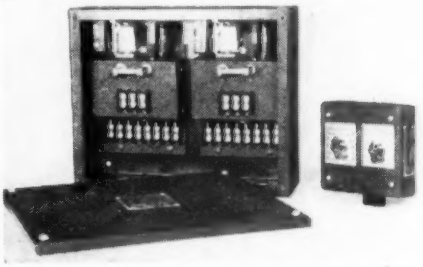
Write Today for new Time and Rate Schedule on Air Express. It contains illuminating facts to help you solve many a shipping problem. Air Express Division, Railway Express Agency, 230 Park Ave., N. Y. 17. Or ask for it at any Airline or Railway Express office.

Phone AIR EXPRESS DIVISION, RAILWAY EXPRESS AGENCY
Representing the AIRLINES of the United States

New Equipment

(*Continued from page* 128)

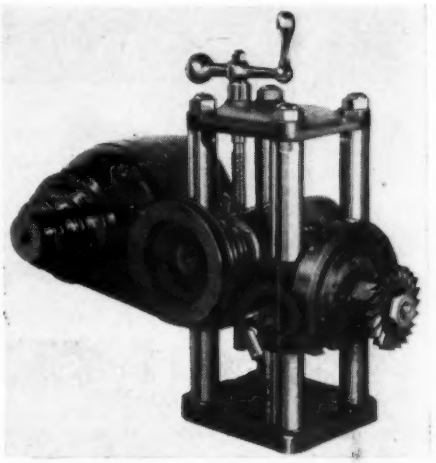
ates this cycle. Provision for automatic recycling is provided. Control is through specially designed snap-action relays. Photoswitch timer Type 2T15U is universal for six maixmum time ranges from 1.5 seconds to two minutes for each cycle period. Each



range is represented by a timing element which is snapped into a clip on control front. Timer may be then set for any intervals up to these maximums by dials, which are located either on timer itself or in a small housing at a more convenient location. Photo shows timer and small dial housing. **Photoswitch Inc, 77 Broadway, Cambridge 42, Mass.**

Coal-Car Shaker

NEW MACHINE shakes sticky, stubborn coal out of cars. Place *Mister Shake* on top of a loaded car; press button to start an electric motor. Seismic action results and coal flows out bottom of car. Two minutes is said to be average time for unloading car. Only two men are required to operate the equipment. **Robins Conveyors, Inc, Passaic, N. J.**



Lathe Converter

FIRST DEVELOPED BY THE ARMY for mobile repair units, worm-gear motor-driven device pictured, plus other attachments now shown, convert standard lathe into a battery of machine tools for milling, cutting external keyways, broaching internal keyways, external and internal grinding, thread milling and other angular milling, gear cutting and other

Important News

. . . to all users of protective coatings

The Dampney Company of America announces its acquisition of *The Thurmalox Company,* makers of a famous line of specialized protective coatings. Outstanding among these are THUR-MA-LOX coatings, in which heat resistance has been developed to extreme limits. In particular:

THUR-MA-LOX NUMBER 7 BLACK — For exterior and interior metal surfaces at temperatures up to 1600°F.

THUR-MA-LOX NUMBER 10 ALUMINUM—For interior metal surfaces at temperatures to 1200°F.

Equally well known products of the Thurmalox Company are THURCO coatings, in a variety of types for widely differing applications.

These quality products now join Dampney's long-established leaders:

APEXIOR NUMBER 1 — For "hot-wet" metal surfaces.

APEXIOR NUMBER 3 — For "cold-wet" metal surfaces.

Together, APEXIOR, THUR-MA-LOX, and THURCO comprise a line of specialized coatings of broad range and dependable protection.

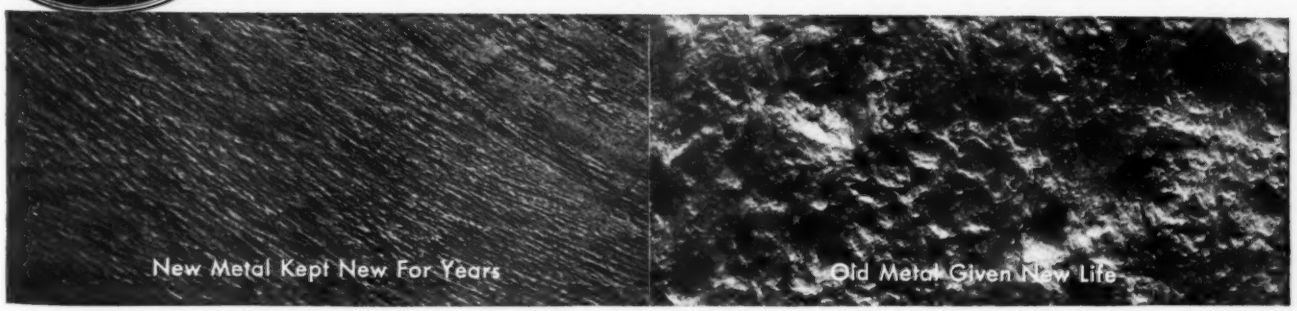
With greatly expanded scope and manufacturing facilities, The Dampney Company looks forward to increased opportunities for service in a wider field.

The Dampney Company of America, Hyde Park, Boston 36, Massachusetts.

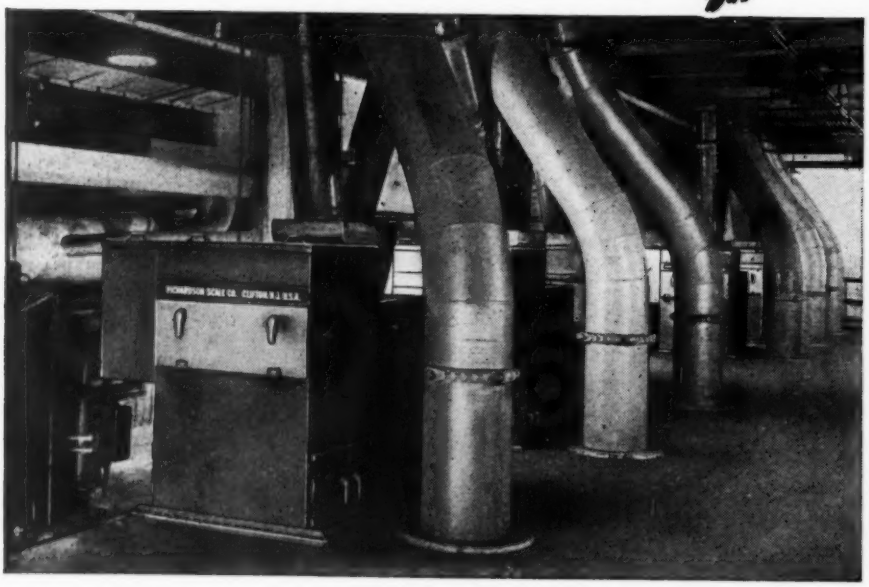
APEXIOR

Keeps new metal new . . . Gives old metal new life

DAMPNEY



DETECT and ELIMINATE FUEL LOSSES



with the aid of RICHARDSON COAL SCALES

Where does inefficiency occur when boilers deliver less than maximum evaporation? There are many sources of lost efficiency, but knowing how much coal is burned will help you to detect and eliminate them.

A Richardson Coal Weighing and Feeding System points out inefficient boilers. It helps get every B.t.u. and kw-hr. that boilers can produce—by providing complete, continuous, comparative records of coal consumed per boiler, per hour, per shift, per week, month or year. With their accurate, automatic easily-read counters, Richardson Scales register indisputable data . . . knowledge which has reduced coal consumption and increased boiler efficiency in hundreds of power plants of every size.

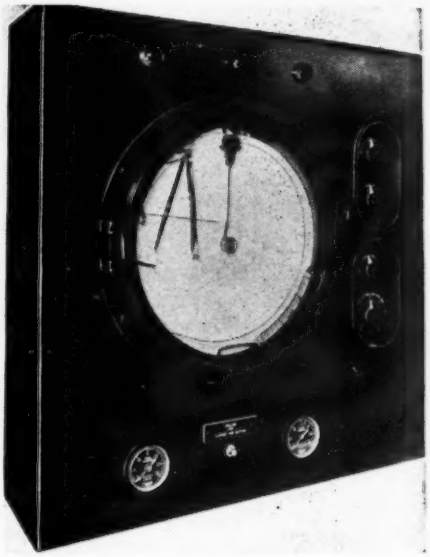
The Richardson System includes: gate and spouts from bunker: inlet chute to scale; the recording scale itself; and Monorate Non-Segregating Distributor to stoker, or downspout to pulverizer. In stoker installations, the Monorate Spreader assures maximum combustion efficiency by distributing coal *evenly* across the stoker hopper without segregation of coarse and fines.

For full details of the thoroughly proved Richardson System of "coal-control economy," write for Bulletin No. 1143.

RICHARDSON SCALE CO.
CLIFTON, N. J.
Atlanta • Boston • Chicago • Omaha • Montreal • New York • Philadelphia
Minneapolis • Detroit • San Francisco • Toronto • Wichita • Pittsburgh

dividing head work, grinding taps, dies, reamers and other tools.

Equipped with its own motor, Master converter uses the lathe's capacity to rotate the work piece without interfering with the cutting or grinding operations performed by the machine. Converter does not restrict normal use of the lathe. It permits many operations to be done with a single setup or chucking in the lathe. Converter is made in three sizes adaptable to all lathe sizes from 9- to 36-in. swing. **Master Manufacturing Co, Hutchinson, Kan.**



Temperature Controller

CONTROLLING, RECORDING AND DUPLICATING CYCLE comprise the service offered by the *CycleLog* controller. No time cams or supplementary instruments need be included because this device, its manufacturer states, is completely automatic. Four setting knobs on the instrument panel predetermine schedule for operation.

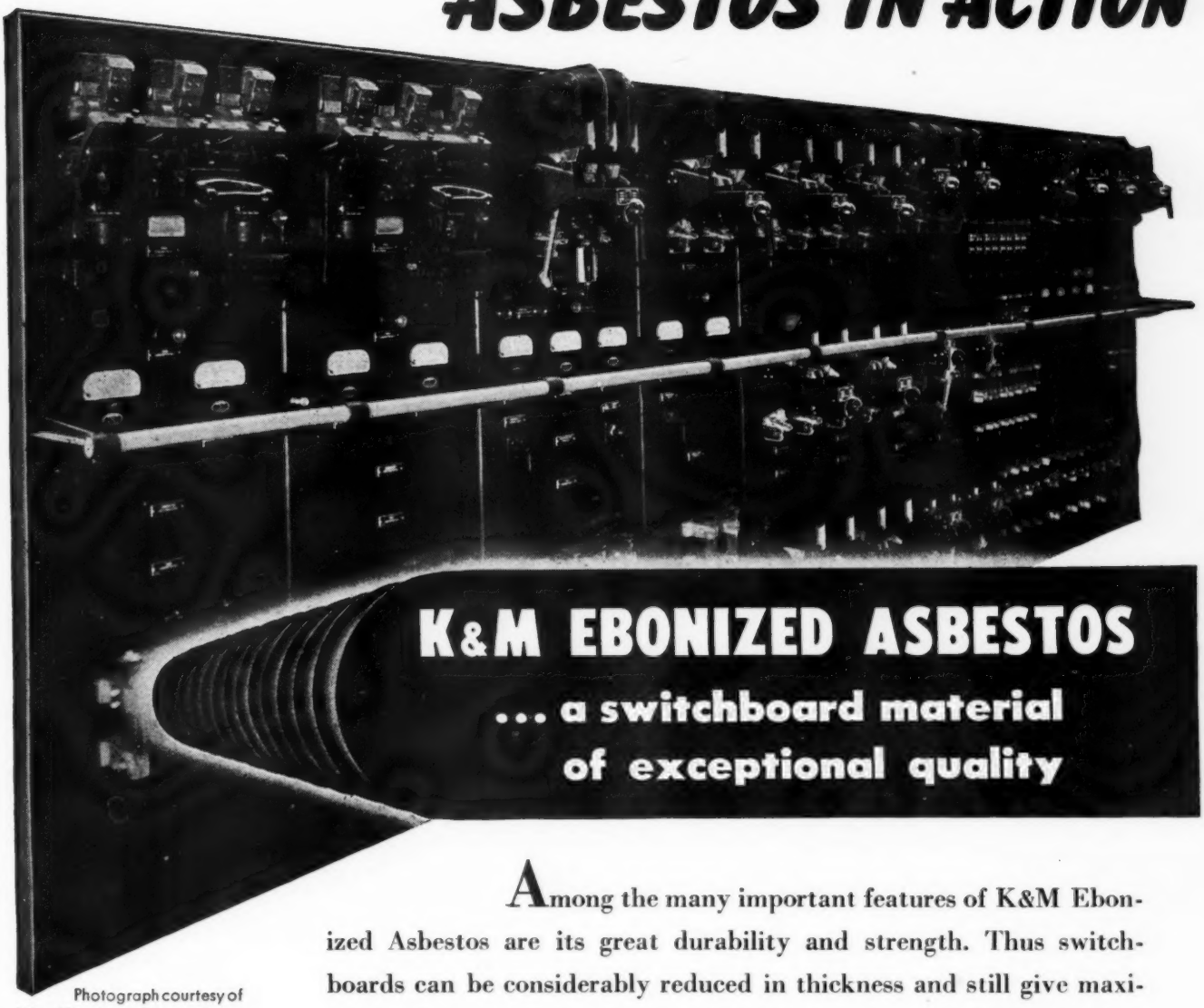
Manufacturer advances these features for the controller: (1) brings temperature up to any desired point regardless of daily or seasonal variations (2) attains this temperature at any desired rate of rise between 1 and 8 deg F per min (3) holds temperature at chosen point for a selected period of time (4) shuts off heat supply and (5) signals operator that cycle has been completed. In addition a complete record has been made on the instrument chart. **Foxboro Co, Foxboro, Mass.**

Blowdown Disposal

QUIET, EFFECTIVE, ADAPTABLE constitute manufacturer's claims for a combination separator and muffler that substitutes for a blowdown tank. Originally designed for locomotive use, improvements possible with unlimited clearances suit centrifugal blowdown separator and muffler for stationary power-plant service.

In operation blowdown from boiler connection enters through tangential jets into a separator and muffler. A vortex forms from this method of entry, allowing steam to pass off vertically through an adequate vent to atmosphere. Separated products, water and sludge, carried into a chamber, enter the

ASBESTOS IN ACTION



K&M EBONIZED ASBESTOS

... a switchboard material of exceptional quality

Photograph courtesy of Wm. Wurdack Electric Manufacturing Co., St. Louis, Mo.

Among the many important features of K&M Ebonized Asbestos are its great durability and strength. Thus switchboards can be considerably reduced in thickness and still give maximum efficiency. Other features, listed below, are equally impressive.

K&M Ebonized Asbestos is made of a combination of asbestos fibre, binding cement and insulating compound, molded under terrific pressure into strong, monolithic sheets. Comes in standard or special "panel" finish . . . from ⅛" to 4" thick.

EFFICIENT FOR BUS BAR RUNS, TESTING TABLES, CABINETS, BENCH BOARDS, COMPARTMENT LININGS AND MANY OTHER TYPES OF ELECTRICAL INSTALLATIONS

•

K&M Ebonized Asbestos is specially developed to meet the technical requirements of Underwriters Laboratories, Inc. when built into an assembled unit.

K&M EBONIZED ASBESTOS FEATURES:

- Exceptionally high dielectric strength
- Uniform density throughout
- Withstands severe shock, vibration and wide temperature variations
- Resists oil and water action
- Does not shrink, crack or bulge

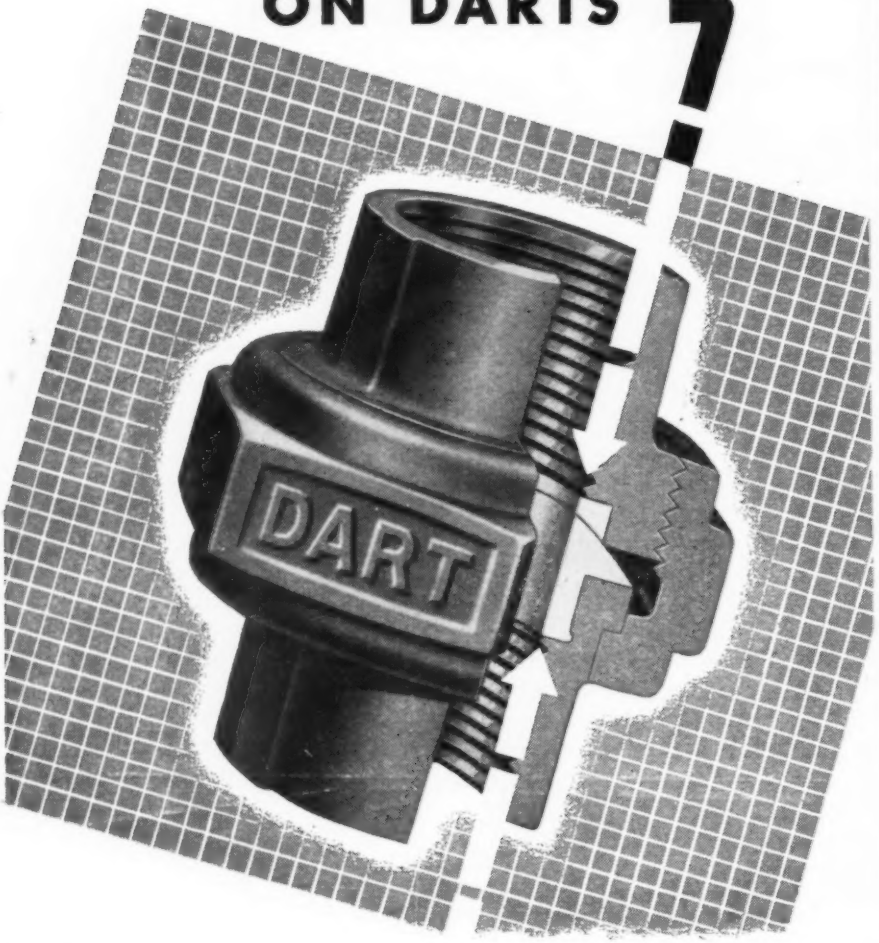
Nature made Asbestos . . . Keasbey & Mattison has been making it serve mankind since 1873.

KEASBEY & MATTISON

COMPANY • AMBLER • PENNSYLVANIA

IMPORTANT DATA

ON DARTS ?



They Have Two Bronze Seats Ground To a True Ball Joint

The importance of this exclusive Dart feature is in that it permits the union to make a drop-tight connection without freezing the seats. Darts may be uncoupled instantly whenever needed for further service. Bodies and nuts are made of high-test air-refined malleable iron—are practically indestructible.

For long, trouble-free service—and consequent low cost—always specify Darts.

DART UNIONS

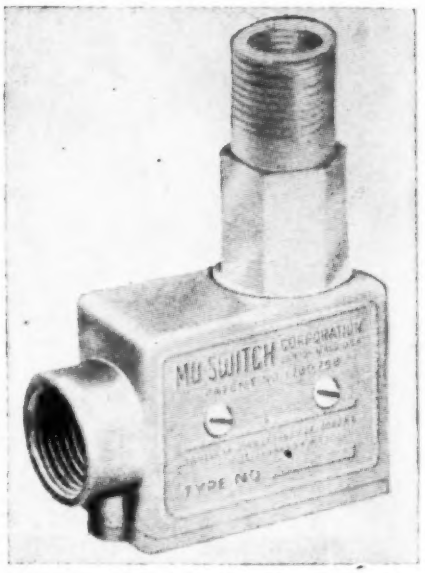
E. M. DART MFG. COMPANY, PROVIDENCE, RHODE ISLAND

sewer by gravity through a supporting pipe. All pressure dissipates in the steam flash through a large opening thus making device a non-pressure vessel and not a hazard under any boiler code. **Wilson Engineering Corp, 122 S Michigan Ave, Chicago 3, Illinois.**

Pipe Plating

SMOOTH, PORE-FREE, DUCTILE DEPOSIT develops within pipes or tubings up to 18 in. dia OD and 20-ft length, claims manufacturer. *Lectro-Clad* process endows steel pipe with corrosion-resistant nickel, electroplated on the inside.

Fittings and pipe-line accessories are available. Welding and fabricating techniques are developed to the point where internally plated pipe can be welded, reduced and bent, hot or cold, without destroying internal lining. **Bart Manufacturing Co, 227 Main St, Belleville, N. J.**



Pressure Control

COMPACT, PRESSURE-SENSITIVE electric control responds to changes in fluid pressure. Its very convenient size, 1x2$\frac{1}{16}$x3$\frac{1}{4}$ in., and durable construction permit installation under adverse conditions. Electric control consists of a single-pole double-throw *Mu-Switch* in two ratings (1) *type M*, 15-amp 125-v ac to 2-amp 600-v ac or 1/2 hp at voltages up to 460 ac (2) *type A*, low-voltage dc, 25 amp at 28-v dc.

Pressure-sensitive portion consists of metal bellows soldered into a brass tube that attaches to the metal housing of the electric circuit. Unit operates up to 300 F under a differential of 5 to 15 lb at nominal ratings of 10 to 120 psi. **Mu-Switch Corp, Inc, 380 Pequit St, Canton, Mass.**

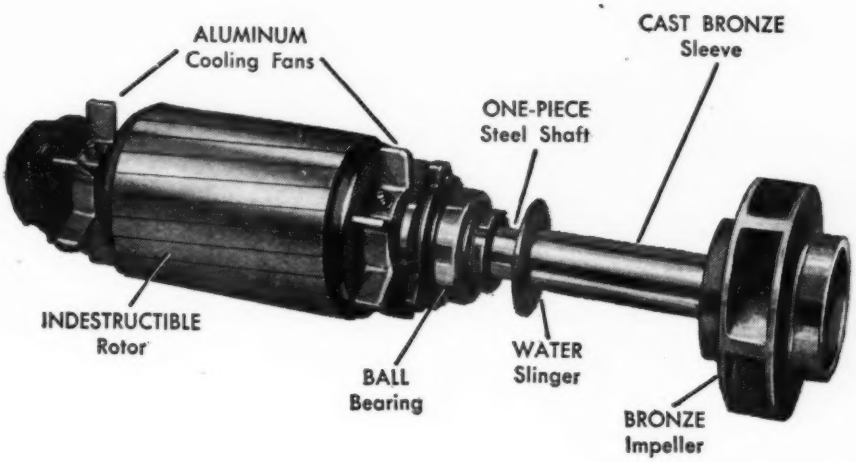
Welding Inspector

PORTABLE CURRENT SUPPLY permits foundry and welding inspections. High-amperage low-voltage current for both dc and ac magnetization and demagnetization allows many applications. Ac output carries ratings at maximum 2500 amp, continuous 500 amp. Heavy-duty dry-plate rectifiers deliver

Here's Key

to Why A-C's Smooth-Running Electrifugal Pump is the Finest of its Kind!

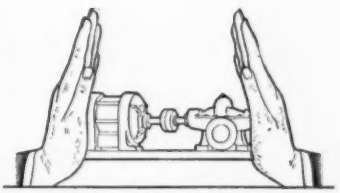
SQUEEZE PLAY CUTS SPACE 33%!



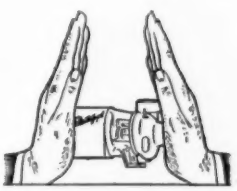
NEW KIND of pumping power now gives you new standards of performance and economy! Allis-Chalmers engineering has combined pump and motor into a single, compact unit—the "Electrifugal" Pump—which takes less space, gives you smooth operation with maximum protection against dangers of abnormal wear, leakage, corrosion, vibration! One-piece iron casting forms motor yoke, bearing housing, pump bracket and feet. One shaft running on 2 ball bearings carries the motor-rotor and pump impeller (see above). Result: true alignment, smooth operation—less maintenance! For you that means extra strength, extra value in terms of operating economy and long life. For complete information about this great pump, call our nearest office, or write ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN.

HEAR THE BOSTON SYMPHONY: *Saturday, American Broadcasting Co.*

A 1933



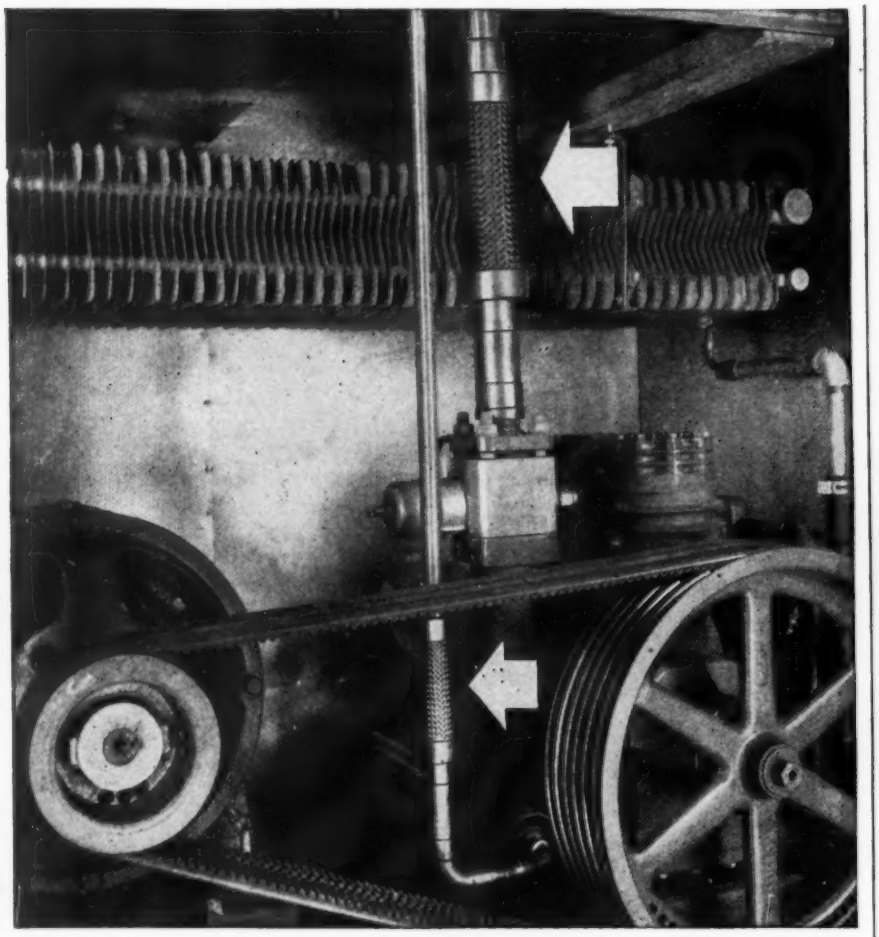
PROBLEM: Here is conventional pump and motor. How can we couple them together *better*—to save space, increase stability, and provide rigid alignment.



SOLUTION: We design a new kind of pumping unit—the one and only "Electrifugal" Pump! Motor and pump are now on one shaft—which cuts space 33%, assures alignment and smooth operation. No wonder "Electrifugals" give you more pumping power for your money!

SEA-BLUE BEAUTY: Modern design of Electrifugal Pump looks well on jobs anywhere! Capacities from 15 to 1600 gpm—heads up to 500 feet.

ALLIS-CHALMERS *Electrifugal* PUMPS



REX *Vibra-Sorbers*
Reduce Vibration Hazards

REX VIBRA-SORBERS—properly installed—substantially reduce servicing costs. For **REX VIBRA-SORBERS** have the exceptional strength and flexibility needed to absorb prolonged vibration and thus prevent the transmission of noises throughout the entire piping system.

In addition, **REX VIBRA-SORBERS** are pressure-tested to insure "refrigerant-tightness." This means greater protection against leakage of valuable refrigerants. **REX VIBRA-SORBERS** of copper bearing alloy are normally used for Freon and Menthol. Units of steel alloys are available for ammonia. Thus, effective corrosion resistance is assured in all types of installations.

Let experienced C.M.H. engineers help solve your vibration problems. Write today for full information.

Flexible Metal Hose for Every Industrial Use

ARMY E NAVY

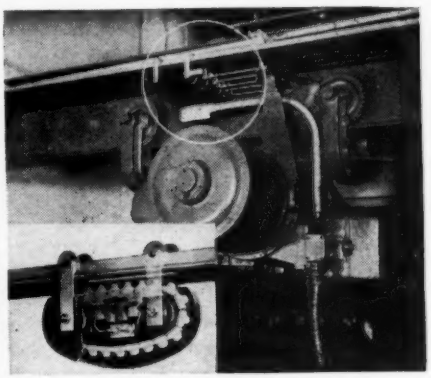
CHICAGO METAL HOSE CORPORATION
MAYWOOD, ILLINOIS

Plants: Maywood and Elgin, Ill.

single-phase half-wave-rectified dc to 1850 amp, maximum; 1000 amp, continuous duty. Selection of current output rests on 8-point tap switch, operating through a pushbutton switch and a 15-ft cable. **Magnaflux Corp, 5900 Northwest Highway, Chicago 31, Illinois.**

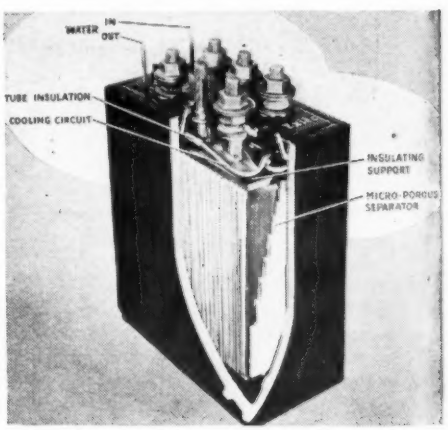
Fire Extinguisher

SMALL, 4-LB CARBON-DIOXIDE fire extinguisher comes with a carrying handle and fast-operating control button. Unit mounts on a wall rack furnished with each extinguisher. A quick-release chain allows ready use. **B F Goodrich Co, Akron, O.**



Insulated Trolleys

LOW WEAR FACTOR and economical operation merit use of fully rubber-insulated *TracTroly*, states its manufacturer. System consists of 10-ft lengths of copper conductor in a slotted back-supported rack. Individual traveling collectors on an endless chain effect positive 6-tooth multiple-contact, reducing arcing, pitting, and fire or explosion hazards. **Benbow Manufacturing Co, Hobart Bldg, San Francisco 4, Calif.**



Storage Battery

INTERNALLY WATER-COOLED storage battery has its capacity effectively increased through greater allowable charge and discharge rates. Decreased maintenance, longer life, more constant-operating temperature and reduction of evaporation comprise advantages, manufacturer claims.

Battery cell uses about 50 in. of ¼ in. OD lead tubing in the electrolyte near the top of the cell. Tap water circulates through the

Simple, positive, modern

BECAUSE IT'S

Electrical

HAYS AUTOMATIC COMBUSTION CONTROL

Just as more and more industrial equipment items are being electrically driven—stokers, pulverizers, fans, blowers and the like—so is it practical good sense to operate an automatic combustion control system electrically. Thus are utilized the advantages of simplicity, speed and dependability inherent in this fool-proof modern method.

Hays Centralized Control is wholly electrical—with enclosed mercury switches for the sensitive contacts; no moisture, no dust, no other foreign material to cause sticking, chattering and excessive wear. Installation is easy, maintenance is simplified. Adjustments are made direct—not dependent on air pressures, oil pressures and numerous valve mechanisms characteristic of non-electrical designs.

For full details concerning this Method of Tomorrow, send for Bulletin 46-605—contains schematic drawings of 14 typical installations. Write for it.

HAYS *Automatic* COMBUSTION CONTROL

THE HAYS CORPORATION • MICHIGAN CITY, INDIANA

These Pumps *Have What it Takes* to Handle Ashes Economically. . .

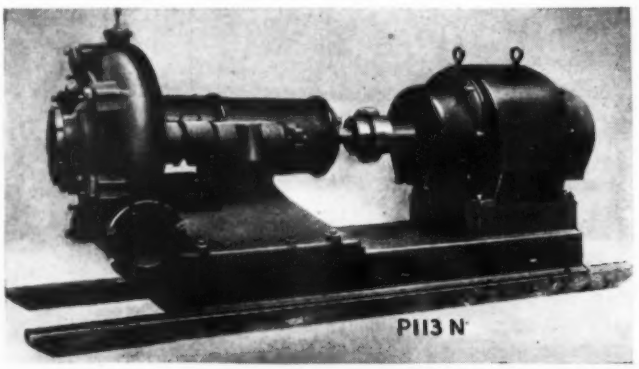
Abrasive materials are destructive to pumps. In handling ashes suspended in solution, high pump maintenance costs are the rule — unless the pump is correctly designed and built for this service. Handling ashes with pumps has definite advantages, but it is important that the right kind of pump be employed.

Amsco-Nagle Pumps are made to handle abrasive material-laden and corrosive liquids efficiently and economically. They offer a new concept in pumps — the worth of which has been proved over an appreciable period of years — a standard advanced design, three horizontal and three vertical types in a wide range of sizes and capacities, with various bearing, shaft and stuffing box designs, *and with water end parts made of the particular metal or alloy ideally suited to the operating condition.*

The Amsco idea of fitting the pump to the job, not only by proper design, but more importantly by wearing parts of correct long lived materials, has resulted in new standards of efficiency and pumping economy.

In the vitally important matter of selecting materials for the water ends for every kind of corrosive and abrasive application, including the handling of ashes, Amsco has back of it the splendid metallurgical laboratory facilities of American Brake Shoe Co. Consequently Amsco-Nagle pumps operate for long periods with sustained efficiency and a minimum of maintenance and out time.

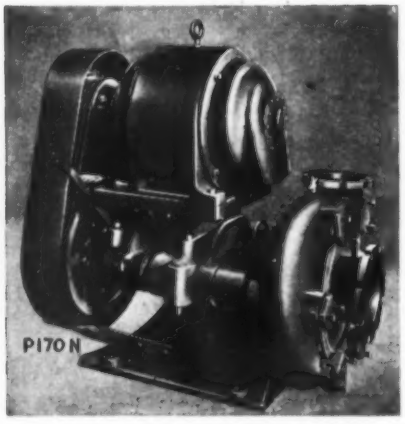
Two installations of Amsco-Nagle pumps for handling ashes are shown in the pictures. Amsco engineers are prepared to cooperate in the solution of your pumping problems.



P-113-N. 8" Type "T" frame 24 Amsco-Nagle Pump, driven by a 75 h.p., 720 r.p.m. motor, for handling ashes in a power plant.

P-170-N. 6" Type "T" frame 19 Amsco-Nagle Pump with 40 h.p. 1,800 r.p.m. motor on a movable pedestal mounted above the pump, which is driven by "V" belts at 720 r.p.m. Pump handles ashes in a power plant.

Ash Handling Drag Chain of Tough Manganese Steel is described in Bulletin 543G.



AMSCO

Foundries at

Chicago Heights, Ill.; New Castle, Del.; Denver, Colo.; Oakland, Calif.; Los Angeles, Calif.; St. Louis, Mo.

Offices In Principal Cities

AMERICAN MANGANESE STEEL DIVISION

CHICAGO HEIGHTS • ILLINOIS

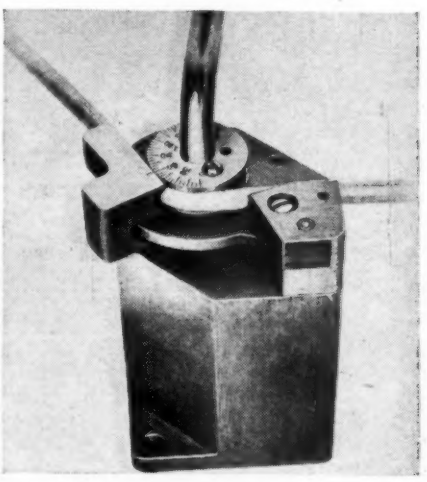
AMERICAN Brake Shoe COMPANY

tubing at a predetermined rate. Lead tubing is insulated from battery plates by special hard rubber and from battery terminals by inclosing tubing in rubber sleeves. Present use is with Progressive Welder Co's battery-powered resistance welders. **Electric Storage Battery Co, Allegheny Ave at 19th St, Philadelphia, Pa.**

Lock Fastener

UNIFORM TIGHTENING and boltlike gripping feature this gun-applied fastener. *Lockbolt* **(1) draws work together in a bolt action (2) fills hole completely if required and** (3) locks permanently and rigidly in place. Elements of fastener comprise a pin with head of any specification, locking grooves, breakneck and pull grooves that fit the jaws of a gun, and a locking collar.

A pneumatic or hand-operated gun, both available, squeezes work together between the collar and the head of the pin; wire draws pin to a press fit to fill hole if so required; swages collar into locking grooves in the pin; breaks pin off flush with collar and frees itself from swaged collar. Fasteners come in 3/16 in. dia, with grip lengths from 1/32 to 21/32 in. **Huck Mfg Co, 2480 Bellevue Ave, Detroit 7, Mich.**



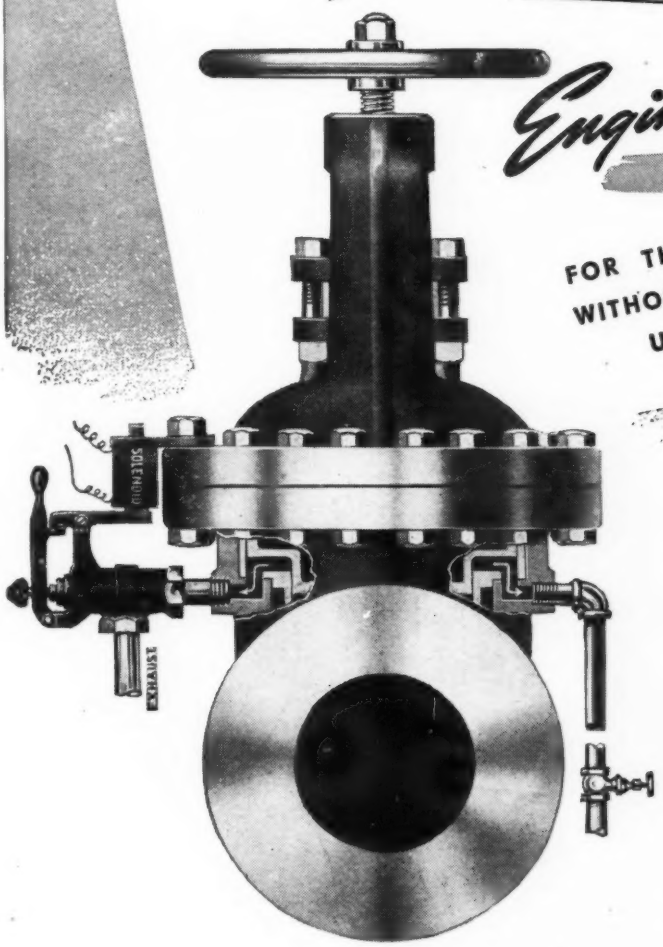
Tube Bender

ACCURATE, QUICK, UNDENTED TUBE-BENDS result from use of a steel-based bender. Bender consists of (1) a sturdy steel base (2) a revolving radius rod equipped with a handle for turning (3) a grooved stop-block to hold

INSTANT! AUTOMATIC! UNFAILING!

Engineered Protection

FOR THE MOST EXACTING INSTALLATION
WITHOUT BANGING, CHATTER OR SPINNING
UNDER ANY FLOW CONDITIONS



GOLDEN-ANDERSON

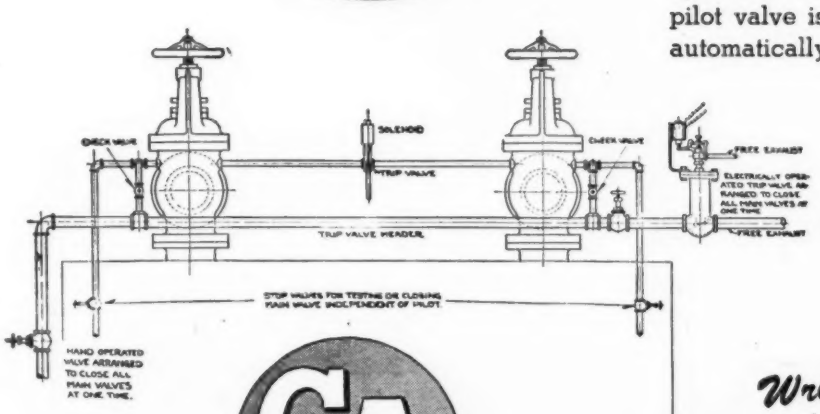
Electric

EMERGENCY TRIP

VALVES

With the AC or DC Solenoid Trip Pilot Valve reset in its closed position, the valve will automatically open as the handwheel stem is run up. When the trip pilot valve is opened, the main valve will instantly, automatically close and remain closed until the trip pilot valve is manually reset. Main valve may be closed at any time with the handwheel.

Write for descriptive technical catalog listing more than 1500 sizes and types of engineered Golden-Anderson Valves.


CHECK VALVE
SOLENOID
TRIP VALVE
CHECK VALVE
FREE EXHAUST
ELECTRICALLY OPERATED TRIP VALVE, ARRANGED TO CLOSE ALL MAIN VALVES AT ONE TIME
TRIP VALVE HEADER
FREE EXHAUST
STOP VALVES FOR TESTING OR CLOSING MAIN VALVE INDEPENDENT OF PILOT
HAND OPERATED VALVE ARRANGED TO CLOSE ALL MAIN VALVES AT ONE TIME.

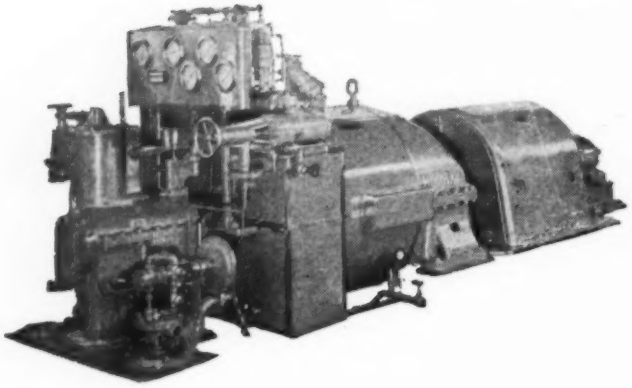
Arrangement of Valves with individual solenoid pilot control, as well as for simultaneous closing by master solenoid pilot valve with valve header unit.

Write for descriptive technical catalog!

GA

GOLDEN-ANDERSON
VALVE Specialty Company
FULTON BUILDING • PITTSBURGH 22, PA.

MURRAY
STEAM TURBINE GENERATING UNITS



Installed in 1939 in a small municipal power plant in northeastern Indiana, the above 500 KW direct connected Murray steam turbine generator set has given its owners entire satisfaction. The turbine is equipped with every device necessary for minimum of attention including steam turbine driven auxiliary oil pump. The generator and exciter may be furnished to match existing electrical equipment in your plant.

Units in this size may be furnished either direct connected or geared as preferred with performance and operation equally trouble-free.

There is a Murray representative ready to help you with design and lay-out information.

MURRAY *also produces*

Mechanical Drive Turbines—Horizontal and Vertical Reduction Gears of the high speed type Steam Boilers

MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA
Builders of Steam Power Equipment for Three Quarters of a Century

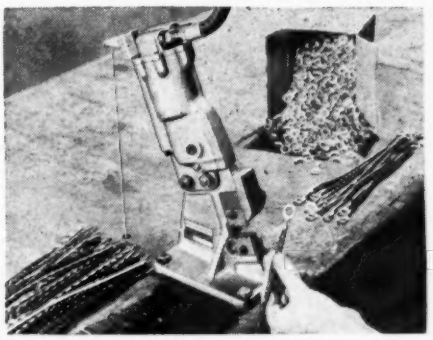
tubing (4) a movable radius block that guides tubing around a roll centered on top of the base. Roll, cylindrical in shape, has a top plate scribed in 360 deg. A measuring point placed on the movable radius block serves as a guide.

In operation a tube inserted in the stop-block groove has the movable block brought up against it with its measuring mark at zero. Operation is completed by pulling the movable block until this measuring mark is opposite desired degree of bend. **Glenn L Martin Co, Baltimore, Md.**

Evaporator Descaler

NEUTRAL, PENETRATING, READY-TO-USE AGENT effects descaling of evaporator tubes and coils by getting between metal and deposit. Used in conjunction with a cold shock to speed up cracking and dislodging of scale deposits, manufacturer states it can bring an evaporator back to full-rated capacity in a total treatment period of 12 hr.

Scale-off is further reputed to be chemically neutral so that it does not break down into harmful byproducts upon heating. **TruTest Laboratories, 261 S 3rd St, Philadelphia, 6, Pa.**



Electrical Connections

QUICK, AUTOMATICALLY CONTROLLED pneumatic press makes up *Hydent* (indent-type) connectors on electrical wire. Single pair of dies accommodates three sizes with present dies covering connectors from No. 22 to 10. **Burndy Engineering Co, Inc, 107 Brucknner Blvd, New York 54, N. Y.**

Plastic Seals

AIR- AND WATER-TIGHT SEALING CAPS and sleeves of plastic composition possess good electrical insulating properties, manufacturer claims. A unique characteristic assures tight sealing fit by allowing expansion to 50% of normal size, when soaked in *GE Dilator* solution, and consequent shrinking to less than normal upon drying. **Chemical dept, General Electric Co, Pittsfield, Massachusetts.**

Metalizing Gun

MECHANICALLY MOUNTED, continuously-operated metalizing gun meets heavy-duty spraying needs. *Type Y* metalizing gun uses 3/16-in. wire combined with acetylene pressure of 15 psi to double spraying speeds. Rugged, large gears, worms, moving parts

(*Continued on page* 170)

NEW CATALOGS, BOOKLETS, BULLETINS

Bring Your Equipment Library Up To Date With This Convenient Service

AIR CONDITIONING, HEATING REFRIGERATION AND VENTILATING

1 CENTRIFUGAL REFRIGERATION—Worthington Pump & Machinery Corp., Harrison, N. J. 24-page bulletin No. C-1100-B14 describes Worthington centrifugal refrigeration systems.

2 STEAM-JET COOLERS—Ingersoll-Rand Co, 11 Broadway, New York 4, N. Y. 22-page form No. 9143-A discusses water-vapor refrigeration with steam-jet coolers.

3 REFRIGERATION INSTRUMENTS—Taylor Instrument Companies, Rochester 1, N. Y. 36-page catalog No. 300 deals with application of control instruments to the refrigeration field.

4 REFRIGERATION EQUIPMENT—Heat Transfer Div, Downingtown Iron Works, Inc, Downingtown, Pa. Sheets cover Downingtown lines of cast-iron support saddles, welded-steel refrigerant receivers, shell and tube condensers and coolers, freon condensers and flooded coolers, closed water heaters, dry-expansion freon water chillers.

BOILERS AND AUXILIARIES

5 COMPACT GENERATORS—York-Shipley, Inc, York, Pa. 6-page bulletin No. G-1044 gives features, specifications and dimensions of Steam-Pak generators.

6 ELECTRIC-WELDED STEEL BOILERS—Brownell Co, Dayton 1, O. 8-page bulletin No. S-67 (Fifth Edition) presents Brownell electric-welded steel boilers.

7 FIREBRICK—Ironton Fire Brick Co, Ironton, O. 4-page folder discusses applications of "Ironton Steel" firebrick.

8 BOILER LINE—Union Iron Works, Erie, Pa. 20-page booklet describes basic designs of Union steam-generating equipment.

9 STEAM GENERATOR—C H Dutton Co, Kalamazoo, Mich. Econotherm bulletin No. L presents the new Dutton Conotherm steam generator, which is a completely self-contained fully automatic unit.

10 REFRACTORIES AND INSULATIONS—Refractory & Insulation Corp, 120 Wall St, New York 5, N. Y. Bulletins No. 1-78, 1-76, 1-77, 1-74, 1-73, R-44, R-47, OB-95 and S-2 cover refractories, insulations and combustion chambers.

ELECTRICAL EQUIPMENT

11 MOTORS—Star Electric Motor Co, 200 Bloomfield Ave, Bloomfield, N. J. 8-page file-size condensed catalog bulletin presents specifications and descriptions of standard motors and generators made by Star and describes facilities for building special motors.

12 TEST SETS—General Electric Co, Schenectady 5, N. Y. 24-page bulletin No. GEA-4477 contains data and descriptive information on complete line of portable ac test sets from 2000 to 150,000 v. In addition, publication covers listings and descriptions of sphere gaps and current-limiting resistance assemblies for use with ac testing sets.

How To Order Your Bulletins

Be sure to fill out, completely, one coupon for each piece of literature you order. (See sample below.) This gives your request authority and helps the manufacturer to address your copy completely.

When you have filled out completely one space for each catalog or bulletin you want, detach along the scored lines and drop the card in the mail.

Example

Write in circle number of item describing one catalog wanted → (17)
Your Company Name *Brown Mfg Co.*
Address *3718 First Avenue Pottsville, Okla.*
Your Name *John Smith*
Your Title *Power Engineer*
POWER, 330 West 42nd St., New York

13 MOTOR—Crocker-Wheeler Div, Joshua Hendy Iron Works, Ampere, N. J. 4-page bulletin describes the company's SEALEDPOWER motor. It is available in sizes from 2 to 15 hp. Bulletin includes a cutaway view and pictures of applications.

14 FLUORESCENT LIGHTING—Fostoria Pressed Steel Corp, Fostoria, O. 8-page booklet No. FL-745, entitled "Better Lighting on the Job," gives recommendations for better lighting in critical work areas. 4-page catalog presents machine, bench and table models of Fostoria lighting line.

MAINTENANCE AND SAFETY EQUIPMENT

15 TOOL GRINDER—Joshua Hendy Iron Works, Sunnyvale, Calif. 8-page pamphlet No. JHA-16 describes the Hendy-Larsson reamer and cutter grinder.

16 METALLIZING GUN—Metallizing Engineering Co, 38-14 30th St, Long Island City 1, N. Y. 12-page booklet gives a brief but detailed description of Metco Type Y metallizing gun.

17 SAFETY TOOLS—Ampco Metal, Inc, 1745 S 38th St, Milwaukee 4, Wis. Data sheet, entitled "Safety Tools of Ampco Metal," discusses a new line of safety tools made of monel metal.

MAINTENANCE MATERIALS

18 LEATHER PACKINGS — Alexander Brothers, 406 N 3rd St, Philadelphia 23, Pa. Folder presents a table of standards governing the correct proportions and dimensions of leather packings for practically every purpose. 4-color folder pictures an assortment of various Alexander leather packings.

19 HYDRAULIC PACKING—E I du Pont de Nemours & Co, Wilmington 98, Del. 16-page booklet relates the story of Du Pont Rayon T 126, special fiber for hydraulic packing.

20 JOINT-SEALING COMPOUND—Quigley Co, 527 Fifth Ave, New York 17, N. Y. 4-page bulletin No. 208 gives advantages of Q-Seal joint-sealing compound for preventing joint leakage in equipment carrying high-pressure steam, oil, gasoline, brine, creosote, acid, ammonia or tar.

21 CORROSIONPROOF MASONRY—U. S. Stoneware Co, Akron 9, O. 52-page booklet No. 810, entitled "Corrosion-Resistant Masonry Material and Construction Manual," is full of helpful facts and suggestions pertaining to materials and construction methods for tanks, towers, sumps, floors and other masonry construction.

MATERIALS HANDLING

22 TRANSMISSION BELTING — B F Goodrich Co, Akron, O. 4-page catalog section No. 2100 describes line of transmission belting, with tables listing stock sizes.

23 LIFT TRUCKS—Towmotor Corp, 1226 E 152nd St, Cleveland 10, O. Compact product data file tells complete story of Towmotor equipment.

(See other side for additional bulletins)

FILL OUT AND MAIL TODAY! NOT GOOD AFTER MAY 1, 1946

Write in circle number of item describing one catalog wanted → ○
Your Company Name .....
Address .....
.....
Your Name .....
Your Title .....
POWER, 330 West 42nd St., New York 2/46

Write in circle number of item describing one catalog wanted → ○
Your Company Name .....
Address .....
.....
Your Name .....
Your Title .....
POWER, 330 West 42nd St., New York 2/46

Write in circle number of item describing one catalog wanted → ○
Your Company Name .....
Address .....
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Your Name .....
Your Title .....
POWER, 330 West 42nd St., New York 2/46

Write in circle number of item describing one catalog wanted → ○
Your Company Name .....
Address .....
.....
Your Name .....
Your Title .....
POWER, 330 West 42nd St., New York 2/46

24 **CONVEYOR BELTS**—B F Goodrich Co, Akron, O. 4-page catalog section No. 2220, entitled "Guide to the Selection of Conveyor Belt Grades," discusses differences in various grades. Publication outlines reliable measurements of qualities in various belts and services for which they are commonly applied.

25 **LOAD HANDLING** — Elwell - Parker Electric Co, 4205 St. Clair Ave, Cleveland 14, O. Booklets, entitled "The Logistics of Boxes," "The Logistics of Barrels," "The Logistics of Bags," and "Logistics of Bales," covers kinds of loads and economical methods of handling them.

26 **GRAB-BUCKET CRANES**—Harnischfeger Corp, Milwaukee 14, Wis. 28-page book describes P&H grab-bucket cranes, which are particularly suited for handling solid fuels and bulk materials.

27 **BELT JOINT** — B F Goodrich Co, Akron, O. 4-page catalog section No. 2155 features an illustrated step-by-step description of making rubber belts endless by the Flylock belt-joint method.

PIPING, FITTINGS VALVES AND SPECIALTIES

28 **FLEXIBLE DUCT** — Spiratube Div, Warner Brothers Co, Bridgeport 2, Conn. 6-page folder presents Spiratube for moving air, other gases or light solids.

29 **VALVE RECORD SHEETS**—Jenkins Bros, 80 White St, New York 13, N. Y. Valve repair and replacement record sheets give a clear, complete picture of valve's fitness.

30 **TUBING FITTINGS** — Gustin - Bacon Mfg Co, 1416 W 12th St, Kansas City, Mo. 4-page folder discusses benefits you obtain from Flexigrip tubing fittings for high and low pressures.

31 **SAFETY AND RELIEF VALVES**—Farris Engrg Co, 400 Commercial Ave, Palisades Park, N. J. Catalog No. 45 describes complete line of safety and relief valves. Many new valve designs and improvements in old designs are included. A condensed bulletin and price sheet is contained in supplement No. 45A to the Farris catalog.

32 **GATE VALVES** — Everlasting Valve Co, 49 Fisk St, Jersey City 5, N. J. 16-page bulletin No. E-150 shows industrial and process-line applications for which these lever-operated gate valves are particularly advantageous.

33 **NEEDLE VALVES**—Bert Borders & Co, 116 New Montgomery St, San Francisco 5, Calif. Bulletin No. 19 describes stainless steel micro-regulating needle valves for pressures to 2000 psi.

34 **STEAM TRAPS**—Strong, Carlisle & Hammond Co, 1392 W 3rd St, Cleveland 13, O. Catalog No. 67 presents improved line of inverted-bucket steam traps.

35 **SPRING HANGERS AND VIBRATION ELIMINATORS**—Power Piping Div, Blaw-Knox Co, 1525 Pennsylvania Ave, N S, Pittsburgh 12, Pa. 32-page catalog No. 2026, entitled "Blaw-Knox Functional Spring Hangers and Vibration Eliminators," gives many details concerning standard and special types and sizes of functional spring hangers and vibration eliminators, with instructions for their installation, and engineering information that will be of help when adoption of this support is under consideration.

PRIME MOVERS AND ACESSORIES

36 **STEAM TURBINES** — Allis - Chalmers Mfg Co, 598, Milwaukee 1, Wis. 12-page bulletin No. B6367 presents a pictorial description of the company's wartime experience in producing steam turbines for maritime use.

37 **BAROMETRIC CONDENSERS** — Ross Heater & Mfg. Co, 1415 West Ave., Buffalo 13, N. Y. 4-page bulletin No. 4609 describes counter-current barometric condensers with non-clogging spray nozzles.

38 **CONDENSER TUBE PROTECTORS**—Crane Packing Co, 1811 Cuyler Ave, Chicago 13, Ill. 4-page bulletin covers John Crane condenser tube protectors. This bulletin is fully illustrated with typical installations and sectional views.

39 **THERMO-CONTROL FAN**—Evans Products Co, Detroit, Mich. 16-page booklet contains questions and answers based on inquiries received from the field about Evans thermo-control fan for automatic precision temperature control of coolants in internal-combustion engines.

PUMPS

40 **CENTRIFUGAL PUMPS** — American-Marsh Pumps, Inc, Battle Creek, Mich. 6-page bulletin No. 381 (Edition No. 1) covers Type HHM ball-bearing, horizontally split case, two-stage, single-suction centrifugal pumps.

41 **DIAPHRAGM PUMPS** — Marlow Pumps, Ridgewood, N. J. 12-page bulletin No. M45 discusses pumps for handling heavy industrial wastes and residues and for pumping thick compounds and solids in suspension.

42 **GEARLESS PUMPS**—Eco Engrg Co, Dept 113, 12 New York Ave, Newark 1, N. J. Illustrated instruction sheet describes installation and operation of Eco gearless pumps as used for water and oil circulating. Sheet includes pump dimensions, capacity charts, prices and several typical methods of pump coupling.

43 **TURBINE PUMPS** — Worthington Pump & Machinery Corp, Harrison, N. J. 12-page bulletin No. H-450-B33 presents a few of the many services to which Worthington vertical turbine pumps may be applied.

44 **ROTARY PUMPS** — Blackmer Pump Co, Grand Rapids 9, Mich. 4-page bulletin No. 118, entitled "Pumps for the Dry Cleaning Industry," features a belt-driven pump for handling liquids used in dry-cleaning operations.

WATER TREATMENT

45 **DEAERATION**—Elliott Co, Jeannette, Pa. 20-page booklet describes corrosion in general and the part which deaeration plays in checking it. Booklet is illustrated with charts and photographs. Included in the text is a table showing the derivation of the pH factor and a graph indicating the effect of pH on rate of corrosion.

46 **CHEMICAL FEED SYSTEMS**—Milton Roy Pumps, 1300 E Mermaid Ave, Philadelphia 18, Pa. 8-page technical paper No. 51, entitled "What the Power Engineer Needs to Know About Chemical Feed Systems for Water Treatment," by Robert T Sheen, covers the subject thoroughly.

47 **COOLING-WATER SYSTEMS**—W H & L D Betz, Philadelphia 24, Pa. Article, entitled "Once Through and Recirculating Cooling Water Studies," by Dr H Lewis Kahler, discusses results obtained in scale prevention in cooling-water systems.

WELDING

48 **CUTTING ELECTRODES** — Ellwood Products Corp, Ellwood City, Pa. 4-page bulletin describes Ellpro cutting electrodes for underwater or surface cutting.

49 **WELDING METHOD**—W K Mitchell & Co, 2944 Ellsworth St, Philadelphia, Pa. 4-page folder, entitled "Something New in Welding," features the Westport joint method of welding.

50 **WELDING**—Page Steel & Wire Div, American Chain & Cable Co, Monessen, Pa. 8-page booklet, entitled "Guide to Everyday Welding," is offered as a guide in selection of proper electrode or gas welding wire for welding various kinds of material, structure and equipment.

51 **ARC-WELDING ACCESSORIES** — Air Reduction Sales Co, 60 E 42nd St, New York 17, N. Y. 12-page catalog No. 130 describes complete line of accessories for all arc-welding machines and operations.

52 **WELDING ELECTRODES**—Page Steel & Wire Div, American Chain & Cable Co, Bridgeport 2, Conn. Wall chart No. DH-1314 gives chemical and physical properties of all Page welding electrodes and gas welding rods.

53 **ARC-WELDING ELECTRODES**—Wilson Welder & Metals Co, 60 E 42nd St, New York 17, N. Y. 32-page catalog, entitled "Arc Welding Electrodes," provides a guide to electrode users in the selection of the right electrodes for any specific job.

54 **ALLOY WELDING**—Arcos Corp, 1515 Locust St, Philadelphia 2, Pa. New chart on high- and low-alloy welding electrodes includes tables on corrosion resistance, heat resistance, weld metal surfacing, as well as chemistry of the weld metal.

OTHER EQUIPMENT

55 **GOVERNOR**—Monarch Governor Co, 1832 W Bethune Ave, Detroit 6, Mich. 4-page catalog describes a new model of governor that is centrifugally controlled.

56 **GEARS**—Ohio Gear Co, 1330 E 179th St, Cleveland, O. 4-page folder covers Ohio stock gears and reducers.

57 **TACHOMETERS** — Herman H Sticht Co, 27 Park Pl, New York 7, N. Y. 4-page bulletin No. 750 features the new Type U hand tachometer, with five ranges, imported from Switzerland.

58 **THERMOCOUPLES**—Wheelco Instruments Co, Chicago 7, Ill. 32-page bulletin No. S2-6 gives information on selection of proper thermocouples and carries installation aids. It describes and lists prices and recommendations on thermocouples, thermocouple wire, lead wire, heads, connectors, plug and socket assemblies, insulators and protecting tubes.

59 **RUBBER AND SYNTHETIC PRODUCTS**—B F Goodrich Co, Akron, O. 12-page booklet suggests applications of rubber and synthetic products manufactured by Goodrich to industrial designers.

60 **INDUSTRIAL RESEARCH**—Arthur D Little, Inc, 30 Memorial Dr, Cambridge, Mass. 24-page booklet gives some information about Arthur D Little, Inc, an industrial research organization.

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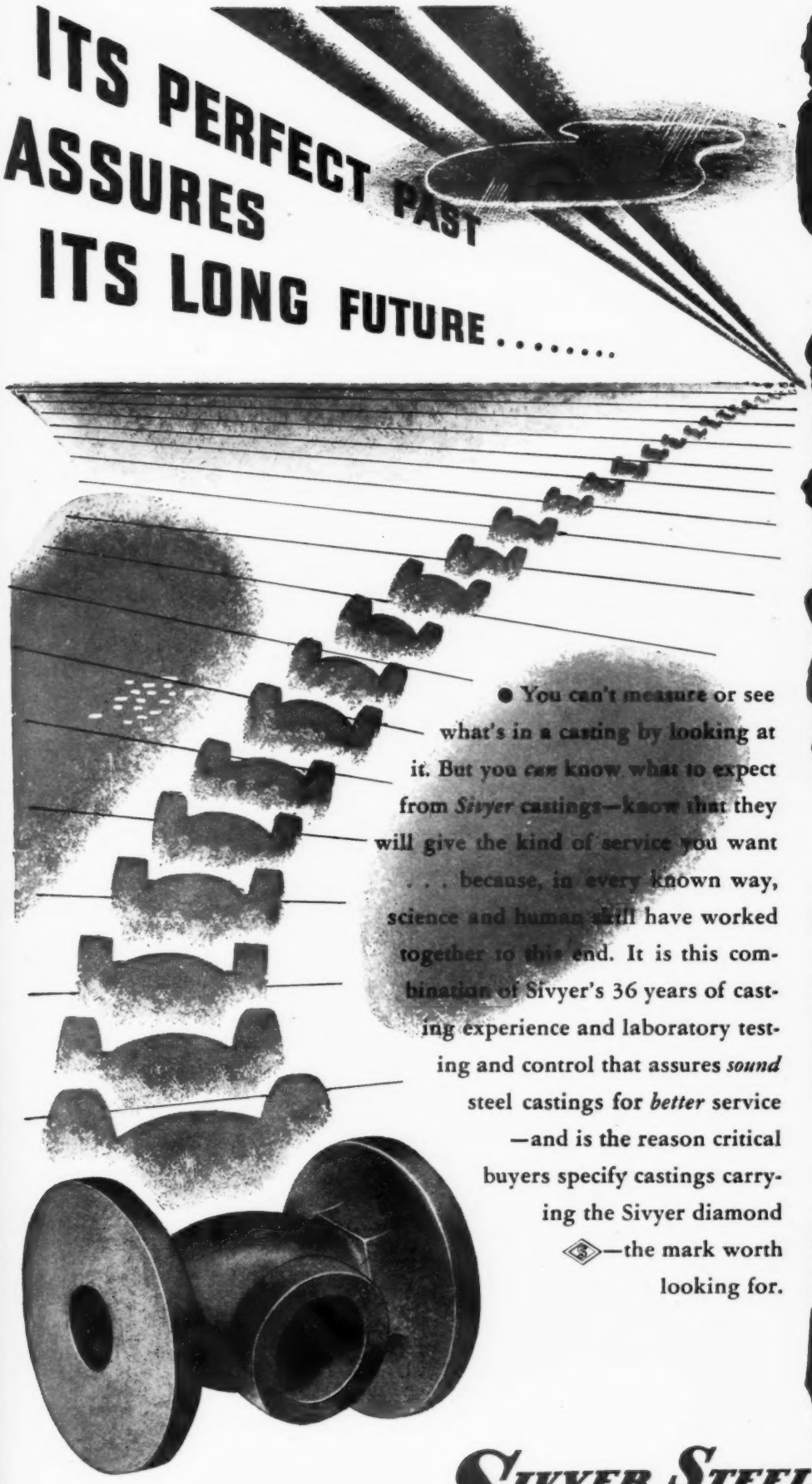

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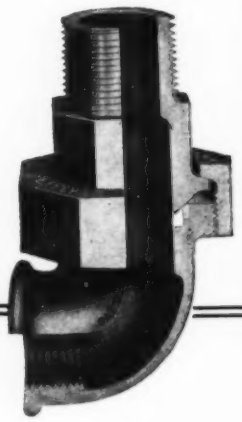

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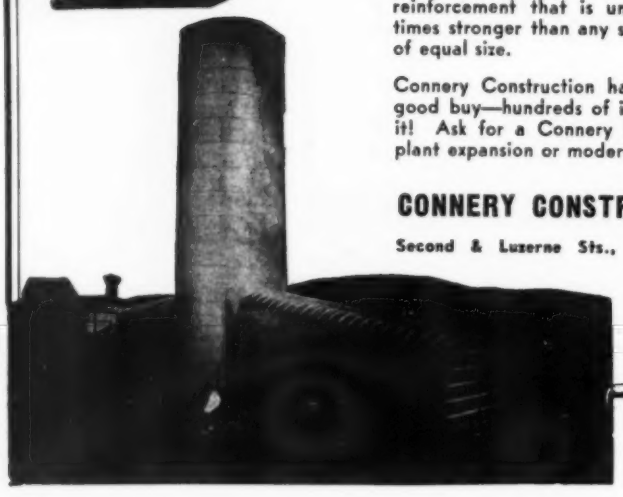


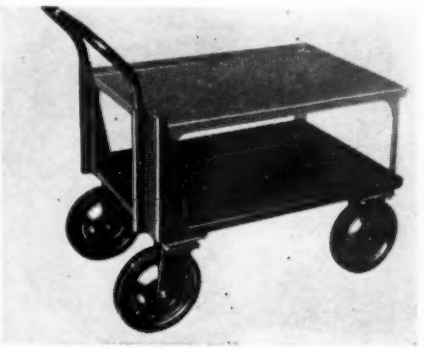
receive fluid lubrication from a built-in forced-feed pump to assure long life and low maintenance. **Metallizing Engineering Co, 38-14 30th St, Long Island City 1, New York.**

Dust Goggle

WIDER VISION, GREATER COMFORT form advantages, manufacturer states, of acetate eyecup, dust goggle. Eyecups, individually shaped, fit contours of right and left eyes. Snug fit, fine wire-mesh screen on inside of each side shield protects against dust yet permits ventilation. *Super Armorplate* lenses are retained by solid fiber rings. **American Optical Co, Southbridge, Mass.**

Valve Control

REMOTE, INACCESSIBLE VALVES operate through a central control assembly. Valve-control box of cast bronze, steel, semisteel or iron comes in various sizes with assembly consisting of flexible cable for transmitting torque to valve handle under operation, as well as sleeve bushings, terminal brackets, cable clips and rod coupling for valve wheel. **J. A. Zurn Mfg Co, Erie, Pa.**



Utility Truck

SHORT WHEELBASE and sturdy all-steel construction combine to give a flexible, rugged truck for transport jobs within the plant. Seamless one-piece steel bed and platform rest on a reinforced steel channel and rubber-tired wheels for loads of 500-600 lb and on plastic wheels for higher loads.

Bed or base of truck is 23¼x33¾ in., and truck handle stands 36 in. above floor. **Drinkwater, Inc, 2323 S Michigan Ave, Chicago 16, Ill.**

Cable Tester

RUGGED, PORTABLE, combined cable tester and locator contains a detector coil and a neutral exploring coil. *Stewart* cable tester weighs 17¾ lb; measures 11x12½x7¾ in. Unit comes with head phones. Built-in level and test-lamp circuit permit accuracy and on-the-spot-checking. **W C Dillon & Co, 5410 W Harrison St, Chicago 44, Ill.**

Floor Scraper

FOUR-BLADED, FLY CUTTER revolves at about 100 rpm to remove imbedded dirt, oil and metal chips or resurface concrete shop floors. Hand screw wheel adjusts the head

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Kansas City 6, Missouri	1332 Oak Street
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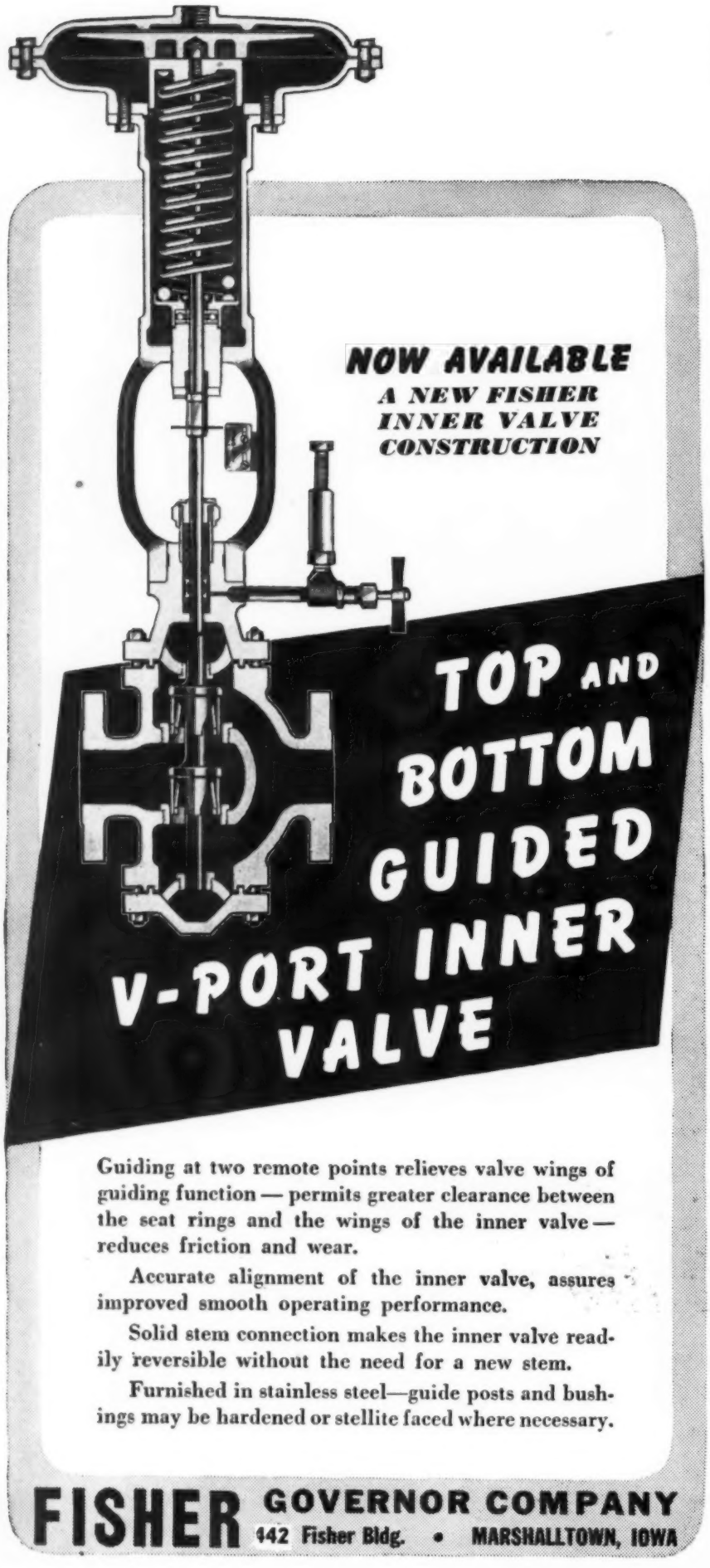
Montreal 20, Canada	5575 Cote Saint Paul Road
Milwaukee 2, Wisconsin	903 East Kilbourn Avenue
New Orleans 4, Louisiana	418 Common Street
New York 13, New York	100 Sixth Avenue, near Canal
Philadelphia 8, Pennsylvania	401 North Broad Street
Pittsburgh 22, Pennsylvania	405 Penn Avenue
Portland 1, Oregon	1433 S. W. Front Avenue
San Francisco 7, California	156 South Park
Seattle 4, Washington	2207 First Avenue, South
St. Louis 3, Missouri	1407 Pine Street
Tulsa 4, Oklahoma	823 South Gary Place
Wilmington, California	524 North Avalon Boulevard



Guiding at two remote points relieves valve wings of guiding function — permits greater clearance between the seat rings and the wings of the inner valve — reduces friction and wear.

Accurate alignment of the inner valve, assures improved smooth operating performance.

Solid stem connection makes the inner valve readily reversible without the need for a new stem.

Furnished in stainless steel—guide posts and bushings may be hardened or stellite faced where necessary.

FISHER GOVERNOR COMPANY
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on this mounted cutter. A guider ring controls the depth of cut with abrasion-resistant carboloy steel blanks employed as protection for this ring. **Carboloy Co, Inc, 11155 E 8 Mile Rd, Detroit, Mich.**

Motor Control

SINGLE-KNOB PRECISION CONTROL operates any reversible motor within any desired range. *Yardeny Pulsin Drive,* its manufacturer claims, operates on all standard currents and frequencies. **Yardeny Engineering Co, 105 Chambers St, New York 7, New York.**

Magnetic Contactor

SMALL, COMPACT SINGLE-POLE CONTACTOR saves panel space, speeds assembly and aids in alignment of part. *Type M* small-frame contactor serves applications in which coil and circuit voltage do not exceed 250 v. Deep-frame units allow greater winding space for operating coil so voltages up to 600 v can be handled. Coil ratings permit operation at 80 to 110% rated voltage for continuous duty. **Westinghouse Electric Corp, Box 868, Pittsburgh 30, Pa.**

Respiratory Protection

REPLACEABLE, CHEMICAL CANISTER serves as heart of *Chemox Oxygen Breathing Apparatus.* This 13½-lb mask with *All-Vision* facepiece generates oxygen by exhaling breath into a simple canister, which removes carbon dioxide and evolves oxygen. **Mine Safety Appliances Co, Pittsburgh 8, Pa.**

Humidity Recorder

PERMANENT, WIDE-RANGE humidity recorder affords coverage from −70 to +60 F of dewpoint of air or gaseous atmosphere. Recorder applies dewpoint principle allowing precise and frequent adjustments of various constituents within a gaseous mixture. **Surface Combustion, Toledo, O.**

Electronic Switch

UNIT NO. 8336 MEETS DEMAND for an electronic switch which, while embodying all other features of United Cinephone switch operating with 30 amp, can also be used in presence of explosive gases. New model uses a relay with contacts which are hermetically sealed. This switch is primarily for pressureless limit switching, floatless control of liquid levels and for eliminating contact arcs and welds. Maintenance beyond replacing the Type 2050 *Thyraton* tube at infrequent intervals is not required. **United Cinephone Corp, 41 Ripley St, Torrington, Conn.**

Protective Coating

WATER-REPELLENT, PROTECTIVE COATING enables re-use of plywood forms for smooth concrete finishes free of grain markings and ready for painting. *Formfilm* coats forms with a 2-layer thickness and is said to prolong wood life. **A C Horn Co, 43-36 10th St, Long Island City 1, N. Y.**

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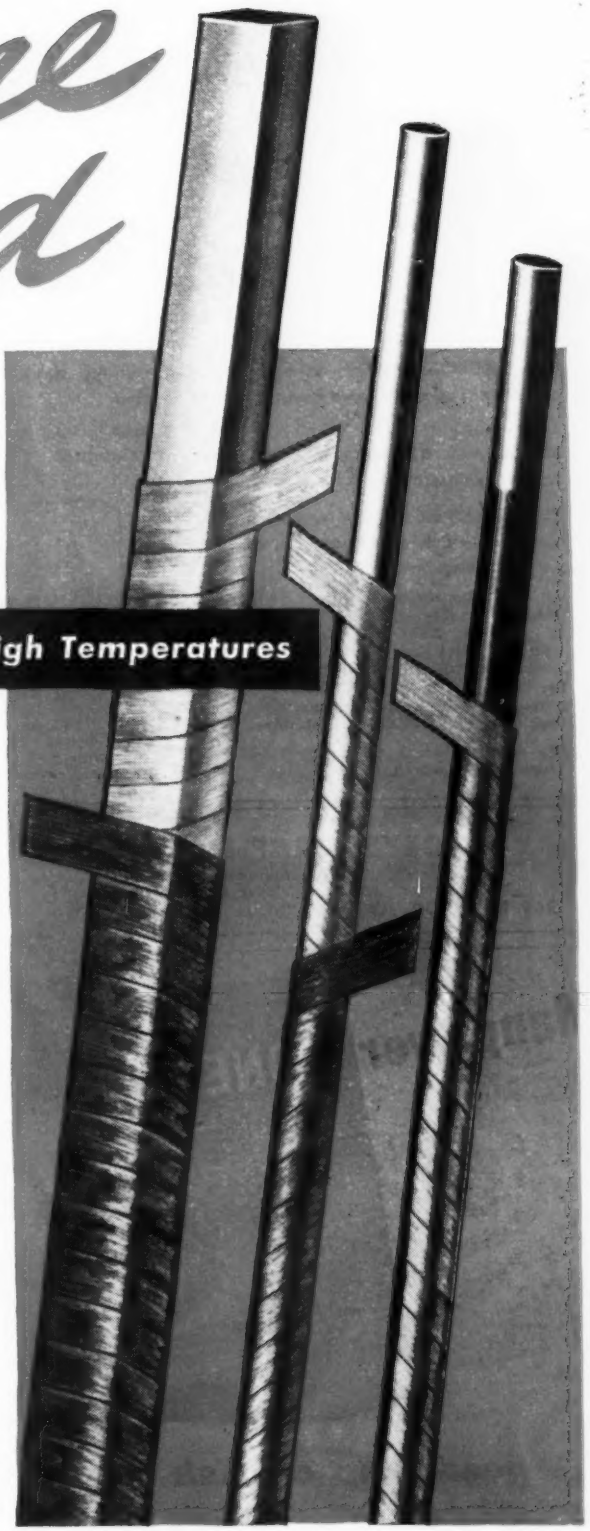
DELTAGLASS MAGNET WIRES

Provide Remarkable Resistance To High Temperatures



One of the most recent developments to come out of General Electric's research laboratory is the new Silicone-treated Deltaglass Magnet Wire. Because Silicone resin offers remarkable immunity to high ambient temperatures this new magnet wire is highly recommended for electrical equipment which operates in temperatures in excess of those that can be met with conventional Class B insulation.

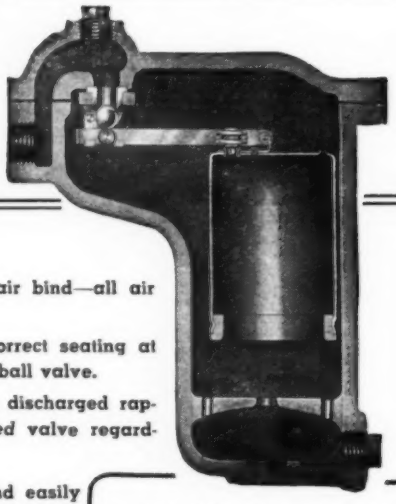
The new Deltaglass Magnet Wires are insulated with a yarn of pure, continuous spun glass that is firmly bonded to the copper with a special Silicone compound to withstand constant, high heat. They are made with either single or double wraps of glass yarn. Silicone-treated Deltaglass is smooth, tough and flexible—particularly suitable for winding motors, lifting magnets, brake coils, generators, etc. It can be wound into the most intricate coils without rupturing the insulation. It's available in round, square and rectangular shapes in a complete range of sizes.

Do you have a magnet wiring problem where excessive heat is essential? You can obtain additional information about Silicone-treated Deltaglass by writing to Section Y268-52, Appliance and Merchandise Dept., General Electric Co., Bridgeport, Conn. All Deltabeston Asbestos-, Glass- and Synthetic-insulated Wires and Cables are distributed by Graybar Electric Co., G-E Supply Corp., and other G-E Merchandise Distributors.

Hear the General Electric radio programs: "The G-E All Girl Orchestra" Sunday 10 P.M. EST, NBC. "The World Today" news every weekday 6:45 P.M. EST, CBS. "The G-E House Party" Monday through Friday 4:00 P.M. EST, CBS.

GENERAL ELECTRIC

There's no time OUT where CRYER goes IN



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THE CRYER is a trap that doesn't air bind—all air is discharged *before* condensate.

THE CRYER is positive in action—correct seating at all times is assured by a free-turning ball valve.

THE CRYER is quick venting—air is discharged rapidly through a *mechanically operated* valve regardless of temperature.

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DESIGNERS • MANUFACTURERS • ERECTORS OF COAL AND ASH HANDLING SYSTEMS

Engineer's Bookshelf

(*Continued from page* 124)

integrated by examples of: economic comparisons between steam, diesel and hydro plants; selection of unit size; adding a unit for a growing load; replacement of existing equipment; and energy interchange between electric systems.

First chapter covers fuels and their characteristics. Five chapters are devoted to the steam power plant and its equipment, one chapter to oil and gas engines, another to hydraulic power plants. Various recent and experimental developments, such as topping turbines, gas turbines, wind turbine, European type of steam generators, tidal power, atomic energy, solar energy are briefly reviewed. Five chapters cover the economics of power equipment selection and the final chapter reviews the classic energy rate forms with some of the difficulties encountered in designing rates.

THE AMERICAN MACHINISTS' HANDBOOK (*eighth edition*) *by Fred H Colvin and Frank A Stanley.* 1546 *pp,* 4½x7 *in., illust, cloth.* $5. *McGraw-Hill Book Co,* 330 *West* 42*nd St, New York* 18, *N. Y.*

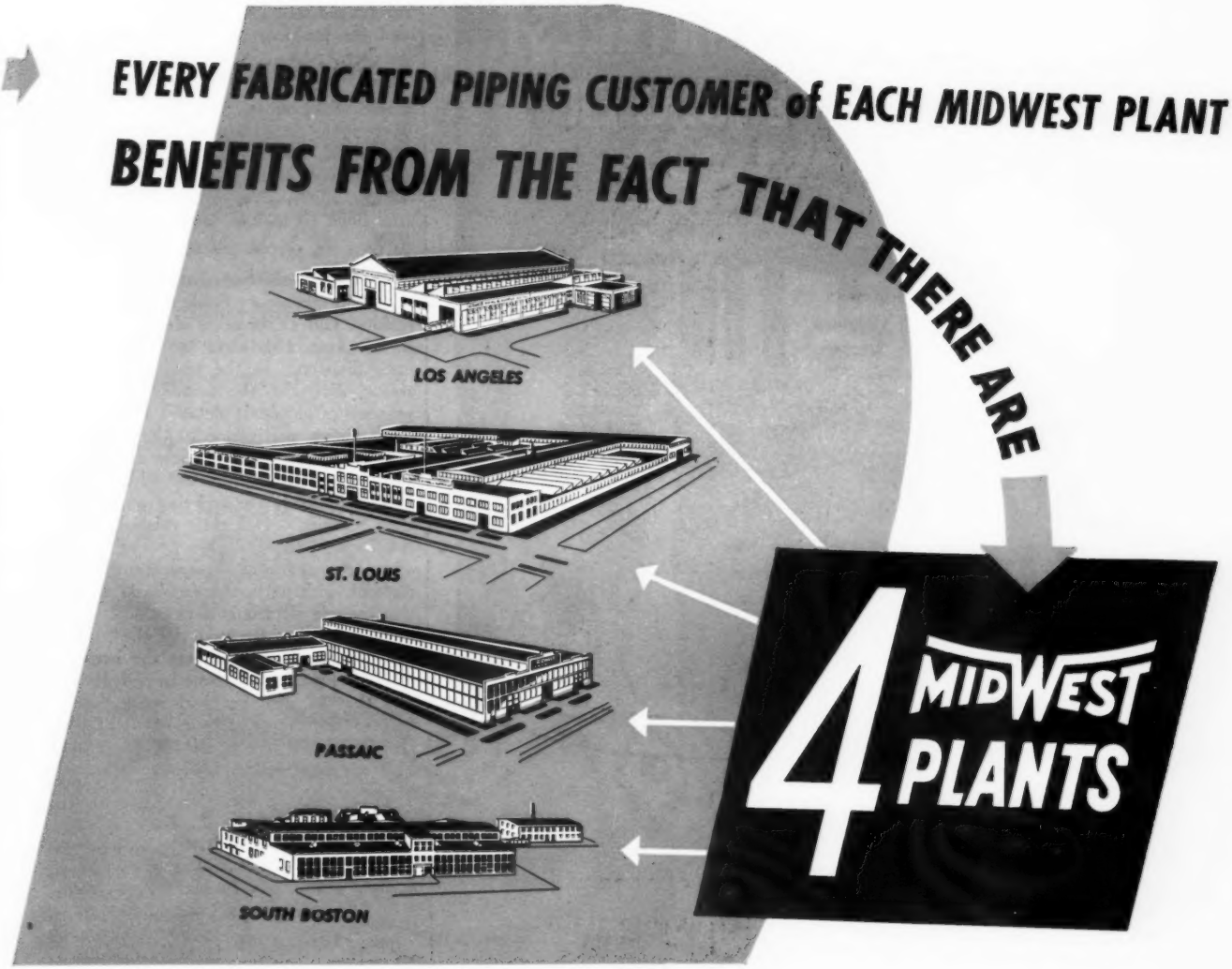
This is the world's most widely used technical handbook in a revised and enlarged edition. It is a standard manual of data, methods and definitions for apprentices, machinists, tool makers, draftsmen, designers, foremen, superintendents. This handbook has long been considered an essential for all responsible people in the metal-working field. Power engineers, too, make frequent use of its data on such matters as screw and nut tolerances, screw-thread standards, keyway dimensions, tap drills, gearing, belting.

INTERNAL COMBUSTION ENGINES (2*nd edition,* 1945) *By V L Maleev, prof of mech engrg, Oklahoma Agricultural and Mechanical College.* 636 *pp,* 5¼x8½ *in.,* 398 *illus, cloth.* $5. *McGraw-Hill Book Co,* 330 *W* 42*nd St, New York, N. Y.*

This second edition of a well-known text, thoroughly revised and brought up to date, continues the philosophy of the original edition—to present the fundamentals of internal-combustion engineering in such a way that the reader may become familiar not only with *what* has been done and *how* it is done, but also with *why* it should be done in a certain way. Although intended as a text for college courses, the book contains much information on basic theory and design principles of value to the practicing engineer anxious to know more about internal-combustion engines. While the reader is assumed to have a working knowledge of thermodynamics and mechanical engineering, the necessary theory as it applies to this subject is reviewed and formulas are derived from basic familiar equations.

Five entirely new chapters have been added in the revision: Combustion in Spark-Ignition engines, Combustion in Compression-Ignition Engines, Compression-Ignition Combustion Chambers, Supercharging, and Gas Turbines. Order of presentation has been

EVERY FABRICATED PIPING CUSTOMER of EACH MIDWEST PLANT BENEFITS FROM THE FACT THAT THERE ARE



Strategically located in various parts of the country, all of the four Midwest plants are of definite benefit to every Midwest customer.

Undoubtedly the most important advantage is the better piping that results from the continuous exchange of information and experience between the four plants. For example, if Passaic develops a new and valuable technique or method, the information is made available at once to St. Louis, Los Angeles, and South Boston. When Los Angeles finds a better way to control grain size in forged lap joints, the other plants are immediately informed. Regardless of which plant fabricates your piping, you get the benefit of the combined experience of all four plants.

Other advantages are greater flexibility in meeting delivery requirements . . . a better understanding of regional conditions . . . source of supply close to the job.

Midwest is logically your first source of piping—whether you want a simple bend, a welded header, or a complete and complex piping job for a large plant fabricated and erected with undivided responsibility.

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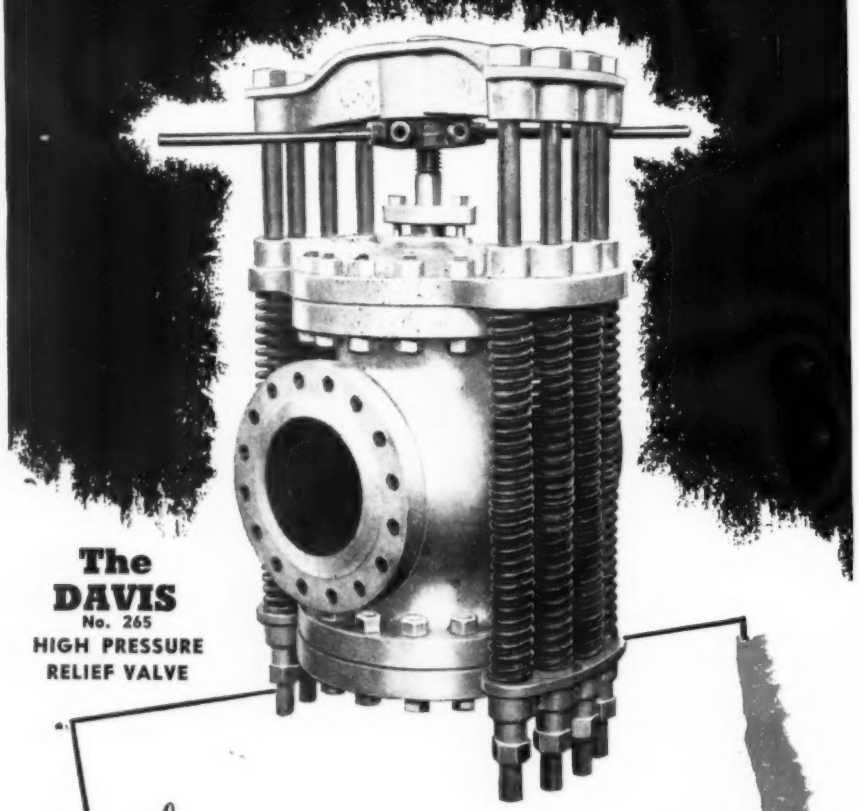
PIPING FABRICATORS AND CONTRACTORS

A VALVE THAT WILL INTEREST EVERY POWER ENGINEER



The DAVIS No. 265 HIGH PRESSURE RELIEF VALVE

for:

- Turbine relief on bleeder system.
- Protection of any boiler room or process equipment by relief to atmosphere.
- Relief of high pressure lines to low pressure lines at predetermined pressure.
- Plants carrying multiple boiler pressures to protect lower pressure systems.

The Davis No. 265 High Pressure Relief Valve, an exclusive Davis design offers numerous features of advantage:

1. Multiple springs — less spring accumulation—less buildup for maximum relief—less blowdown to close.
2. Requires appreciably less head room because of compact design with springs located at sides.
3. Center adjusting screw provides quick, easy change of pressure setting.
4. Can be supplied with test lever.
5. Available with hold open device.
6. Available in semi-steel or steel with bronze or stainless steel trim.
7. Size range 4" to 30".

DAVIS REGULATOR CO.

2540 S. Washtenaw Ave. Chicago, Ill.

DAVIS VALVES

DAVIS REGULATOR COMPANY

rearranged, new illustrations have been added and the problems revised and increased in number.

BASIC ELECTRICAL ENGINEERING—CIRCUITS, MACHINES, ELECTRONICS (1945) *By A E Fitzgerald, associate professor of electrical engineering, Mass. Institute of Technology.* 433 *pp*, 5¾x8¾, *illus, cloth.* $3.75. *McGraw-Hill Book Co,* 330 *W* 42*nd St, New York* 18, *N. Y.*

An integrated treatment of circuit theory, electrical machinery fundamentals and applications, and engineering electronics is given in this text with about equal emphasis on each division. In the machinery and electronic divisions the introductory chapters present a physical picture of the specific field, giving pertinence to the study of the detailed chapters that follow and emphasizing that fundamentally one electromagnetic or electronic device is being studied rather than a series only loosely related. The two concluding chapters give general principles of meters and control equipment and their circuits, with particular emphasis on circuits that include electronic devices.

In presenting the material the author assumes that the student has the background afforded by a basic course in college physics and that he also has had some experience in dc-circuit theory. Mathematics have therefore been used freely, making the book suitable for engineering students or practicing engineers.

ARCTIC AND WESTERN HUDSON BAY DRAINAGE. 360 *pages* 6½x9½ *in., stiff paper.* $1. *Dominion Water and Power Bureau, Dept. of Mines and Resources, Ottawa, Canada.*

This is Volume 88 of water resources papers dealing with surface water supply of Canada. It contains the results of investigations by the Dominion Hydromatic Survey in the Provinces of Alberta, Saskatchewan, Manitoba, Northwest Territories and parts of British Columbia and Western Ontario, for the climatic years Oct 1, 1939 to Sept 30, 1941. The report contains a short explanation of the organization and scope of its work and 339 pages of stream-flow data for rivers and streams within the area mentioned, together with meteorological data, including evaporation for stations in Ontario, Manitoba and Saskatchewan.

ELECTRONICS DICTIONARY (1945) *By Nelson M. Cooke, Lt Comdr, USN, executive officer, Radio Materiel School, Naval Research Laboratory, and John Markus, associate editor, Electronics.* 431 *pp.* 6x9 *in.,* 600 *illust. fabroid.* $5. *McGraw-Hill Book Co,* 330 *W* 42*nd St, New York* 18, *N. Y.*

Electronic applications have developed so rapidly and spread to so many fields that the industry's vocabulary is not so generally understood as it should be. To add to this difficulty many of the terms, which in general are highly technical, are not even in the latest unabridged dictionaries. This illustrated glossary of nearly 6500 terms in radio, television, industrial electronics, communications, facsimile and sound recording has been compiled to provide the electronic industry with a common language.

The book has been written primarily on

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Why pay for COMPLETE equipment then cut its performance with PART-WAY wiring?
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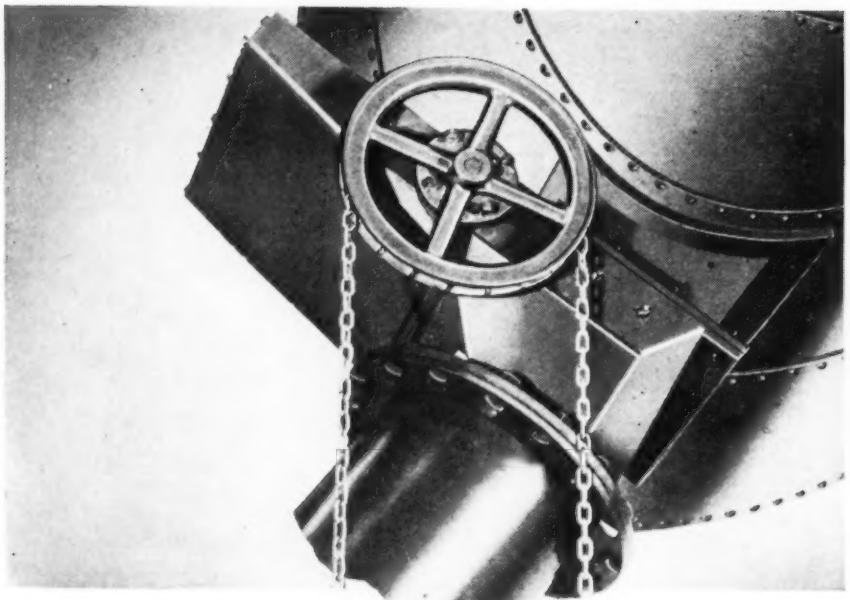
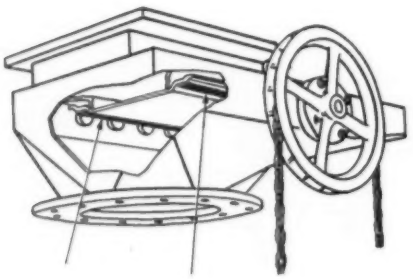


The Double Rack and Pinion Gearing in S.E.Co. Coal Valves won't let them stick!



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Remember wrestling with a coal valve that was "stuck" because of coal dirt accumulation and moisture corrosion? Then you'll welcome the smooth-working S. E. Co. Coal Valve! Its double rack and pinion gearing is completely shielded so that no coal or moisture gathers in working parts—thus there can't be any binding or deterioration of the gears.

Whether it is intended for constant operation or merely standby use you want a coal valve that *works* . . . and your best bet is S. E. Co!

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the level of the student who is learning fundamental electronic principles. However, the terms have been defined with an accuracy required by engineers. Extensive use of illustrations adds much to the clarity of many definitions. Result is a book that will be helpful to everyone interested in electronics —the student, the practical worker and the engineer.

ELECTRIC CIRCUITS AND MACHINES—AN INTRODUCTION TO PRACTICAL ELECTRICITY (1945) *by Eugene C Lister, electrical engineer, Stanley Engineering Co, formerly supervisor of electrical theory instruction, specialized training program, Iowa State College.* 358 *pp.* 5½x8½, 233 *illust. cloth.* $3.50. *McGraw-Hill Book Co,* 330 *W* 42*nd St, New York* 18, *N. Y.*

This book might be considered a war baby because it was developed as a concise outline text for a brief course in the fundamentals of electric circuits and machines, offered during two and one-half years in the specialized training program at Iowa State College. Its first five chapters deal with fundamentals, dc circuits, batteries and magnetism; dc generators, motors and controls are covered in two chapters; ac circuits and generators, poly-phase and single-phase induction and synchronous motors and transformers run through eight chapters; a chapter on electrical instruments and measurements and another on electron tubes completes the text.

Emphasis is on fundamental principles and physical actions that takes place in circuits and equipment rather than on a detailed analysis of the theory involved. The treatment is qualitative rather than quantitative and mathematics has been avoided where possible. Many numerical examples are worked out in detail and problems are included in the chapters in which their solution will assist in illustrating the application of principles being discussed. Because of its practical treatment the book is well suited to vocational schools and to home study by practical electricians and operating engineers.

Drayer-Hanson, designers and manufacturers of heat-exchange equipment, have recently acquired a new factory and offices at 3301 Medford St, Los Angeles, covering an area of about 7 acres. This includes 110,000 sq ft of manufacturing space with all machinery and equipment and a railroad spur extending into the plant, plus 6000 sq ft of office space.

A new smoke ordinance has been passed by City Commission of Birmingham, Ala. Except for the downtown area, buildings housing two families or less are exempt from regulation as far as present heating equipment is concerned. All new equipment, however, whether installed in new residences or in old, must be approved by smoke-control officials. Thus, in the long run, heating equipment in dwelling houses will conform to standards. The ordinance gives the smoke inspector control over installation of industrial heating equipment. Provision, however, is made for an appeal board to study grievances. The board, to be appointed by the City Commission and to serve without compensation, will consist of two combustion engineers, a stoker engineer, a coal operator and a layman.

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High grade gas, by-product and steam coal from Wise County, Va., on the Interstate Railroad.

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High grade gas, by-product, steam and domestic coal from Wise County, Va., on the Interstate Railroad.

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High grade, high volatile steam and by-product coal from Wise County, Va., on the Interstate Railroad.

PREMIX STOKER

A laboratory controlled product blended to meet exacting stoker requirements. From Wise County, Va., on the Interstate Railroad.

COKE

Roda and Stonega from Wise County, Va., and Connellsville Coke from Pennsylvania.

CRITERION COAL

High grade gas, by-product, steam and domestic coal—Pittsburgh seam from Irwin Basin, Westmoreland County, Pennsylvania, on the Penna. Railroad.

CROZER

Genuine Third Vein Pocahontas from McDowell County, W. Va., on the Norfolk & Western Railroad.

Admiralty Coal

Genuine New River Smokeless, Beckley or Sewell seam from Raleigh County, W. Va., C. & O. and Virginian Railroads.

Old Kentucky

Hazard No. 4 and No. 7 steam and domestic coal from Wiscoal, Knott County, Kentucky, on the L. & N. Railroad.

CHARMCO

Unexcelled Steaming Coal from the Fire Creek Seam in Greenbrier County, W.Va., originating on the N.F.&G.R.R.

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Power News

(*Continued from page* 130)

at Paradela, Lavandeiras and Canicadas, bringing the total project to a $16,000,000 cost for a 100,000-kw program.

A $36,000,000 8-year program in the Lisbon area will harness the Zezere River at Cabril, Bouca, Castelo de Bode and Constancia for a 200,000-kw output.

Power Personnel Changes In Nazi Occupation Zone

Allied Control Authority plans to change its administration policy in the U. S. zone of occupied Germany by shifting military government functions to civilian control by June.

Col Walker L Cisler, Detroit Edison chief of power plants, has recently returned to the U. S. after more than two years as U. S. chief in charge of German utilities under the Allied Control Authority. Cornelius W DeForest, Cincinnati, left Dec 3 for Germany to succeed Cisler and serve as chairman of the Electricity and Gas subcommittee, a technical organization that confers on utility problems for all four zones. DeForest will be attached to the staff of Lt Gen Lucius D Clay, U. S. Deputy Military Governor of Germany, for a one-year tour of duty.

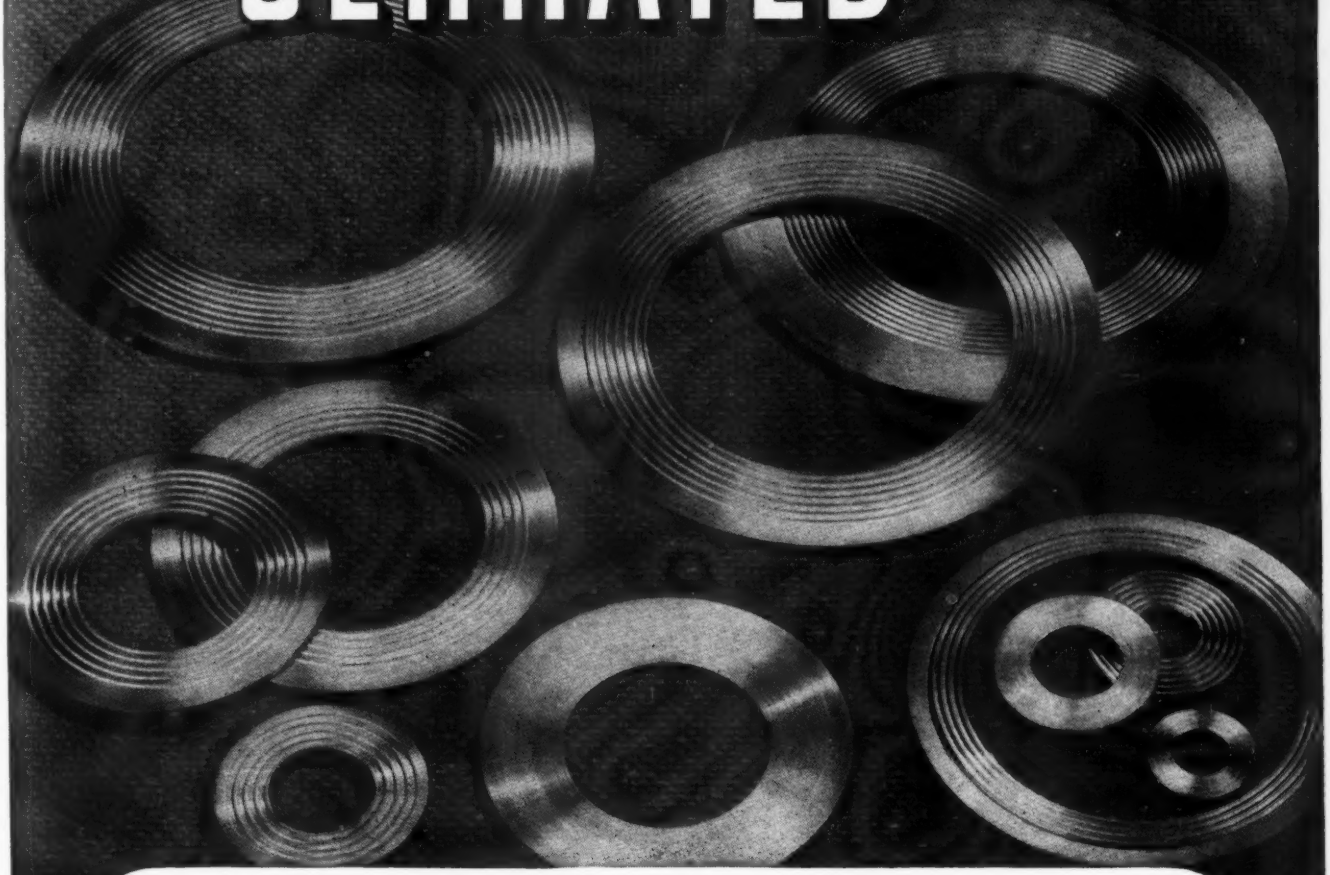
Duties of the American utility section comprise (1) determination of which portions of the German electric, gas, water and sewage facilities within the American zone shall be maintained or repaired (2) supervision, direction, administration of operation of these utilities by German personnel (3) coordination of utility functions within the American zone with those in other occupied areas.

The subcommittee has for its functions the declaration of surplus plants, allocation of power to various uses, rationing of electricity and gas, and import and export of these services from zone to zone. Many of the subcommittee's problems spring from the fact that fuel sources, energy sources and load centers may be in two or more zones. Each nation is supreme in its own area yet each must so conduct its affairs as to allow Germany to exist as an economic entity.

Up to now this job has been handled by Army men under the General Staff's G-5 with Major Gen John H Hilldring commanding officer. By June, however, the Army will supply an occupation force only, no military government. DeForest, then, must recruit a replacement staff by

MODERN DEVELOPMENTS OF GASKET RESEARCH

SERRATED...



Type U

For high pressure steam, process equipment and piping, Goetze Serrated and Profile Gaskets are growing in popularity for services requiring an all-metal gasket having high unit gasket stress at moderate bolt loads.

It is supplied in a wide range of metals and with serrations of a pitch designed to meet the individual needs of specific equipment and operating conditions.

Many hours of laboratory experiment, mechanical and metallurgical research, and years of field experience, have gone into the designing of this Gasket.

Ask to have your name added to the list of engineers receiving "The Gasket"—a series of technical bulletins containing original gasket data emanating from the Goetze Research Laboratory. Write on your company letterhead giving your position.

GOETZE GASKET & PACKING CO., INC.
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Boston	*New York*	*Philadelphia*	*Pittsburgh*
Cincinnati	*Cleveland*	*Detroit*	*Chicago*
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"America's Oldest and Largest Industrial Gasket Manufacturer"

Now is the time to install a . . .

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One-Man System for Stockpiling Coal

Picture shows a Sauerman Scraper System operating in a 10 cu. yd. Crescent bucket on a storage area semi-circular in shape and 400 ft. in radius. This installation handles an average of 400 tons an hour, storing or reclaiming.

Faced with problems of storing more coal without using more labor, your answer is a Sauerman Power Drag Scraper System, requiring only one man at the controls.

At hundreds of plants, Sauerman Systems are storing and reclaiming coal for only a few cents per ton handled, utilizing all available space, piling higher than is otherwise possible, yet in compact layers with no segregation of lumps and fines—no air pockets to promote spontaneous combustion—avoiding the dust and dirt of heavier equipment.

Sauerman Advantages:

Low-cost equipment
One-man operation
Greater safety
Adjustable range

Every Sauerman System is a permanent, trouble-free investment—maintained at small expense.

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8 x 19 Macwhyte Special Traction Steel

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Tough, flexible wire drawn from selected steels in our own mill goes into Macwhyte Elevator Ropes. Strict metallurgical control at every step of manufacture assures a minimum of stretch, yet ample flexibility to withstand bending fatigue.

Your Elevator Maintenance Man can get these low-cost-per-car-mile ropes from Macwhyte Distributors or Mill Depots.

PREformed and Non-PREformed elevator ropes

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Makers of the correct ropes for your equipment

MACWHYTE COMPANY 50th Year 1896 – 1946

NO. 640-C

June estimated to require ten civilians not all of whom need be mechanical or electrical engineers, however. These recruits will (1) remain civilians (2) wear military uniforms without military insignia (3) receive salaries from the War Dept ranging from $6000 to $9000 yearly and, if present plans materialize (4) bring their wives and families to Europe next spring. Service must be for at least one year with career possibilities held probable. Living expenses deducted from salaries run about $180 yearly for billet and about 90c daily for food in established officers' mess.

Interested, qualified persons may reach Col Cisler at Detroit Edison; DeForest at Office of the Military Government of U. S. (Germany) Public Utility Section, Industrial Branch, Economic Div, APO 742, c/o Postmaster, New York, N. Y.

J N Forker, vice-president, tar and chemical div, Koppers Co, announced that negotiations are in progress for acquisition by Koppers of all the capital stock of Wailes Dove-Hermiston Corp, producers of bituminous protective coatings, in exchange for the issuance by Koppers of 15,550 shares of its common stock and payment of $100,000 in cash. General offices and main factory of Wailes Dove-Hermiston are in Westfield, N. J. There are other plants in East St. Louis, Ill., and Houston, Tex. District offices for sales and service are in New York, Philadelphia, Cleveland, San Francisco and Los Angeles. Local representatives are in other cities, including Miami, Houston and Tulsa.

Allis-Chalmers Mfg Co released a 20-page full-color comic booklet, entitled *Jim's Adventure,* explaining how electricity is generated and distributed. This booklet is available to any supplier of electric power and light who requests it, charging a slight fee to help defray printing cost. Distribution to schools and consumer groups will be through local electric light and power companies.

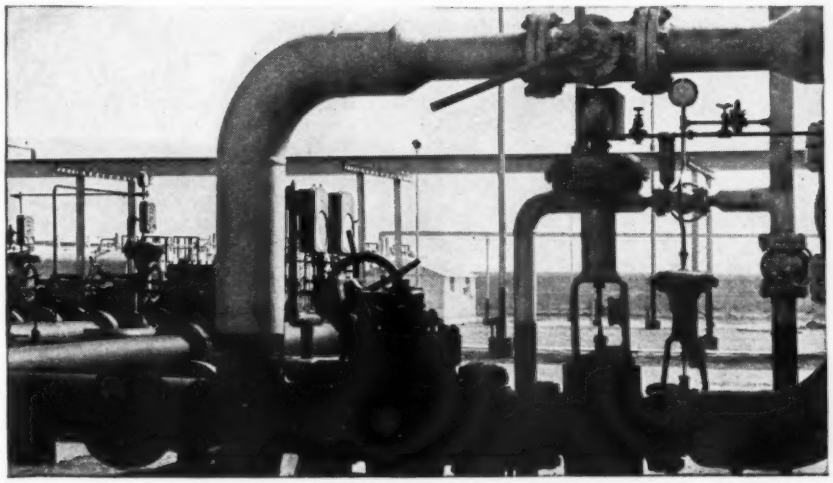
Alexander V Karpov, associated since 1943 with the Foreign Economic Administration in various capacities as an electrical power authority for both North Africa and Germany, has resumed his consultant practice on industrial and power developments with offices in New York. Karpov has also been elected vice-president of King Design and Construction Co, also in New York.

Yeomans Bros Co have signed a lease for a 2-story building at 937 W North Ave, Chicago, which will enable the company to double its production capacity. New building will house the small pump and sewage treatments sections as well as the service dept.

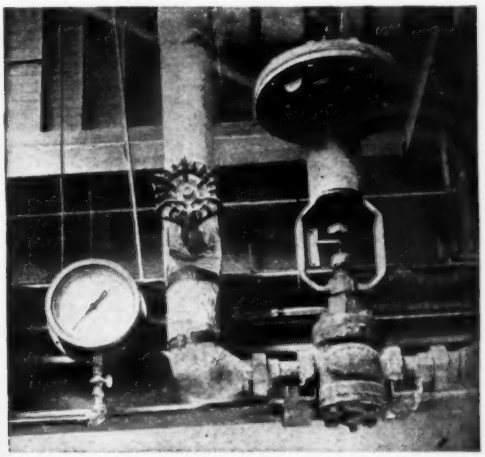
Charles Yeomans, company president, in making this announcement referred to a growing demand already evident for pumps of all kinds now that material controls have been lifted. He further referred to a backlog of 2¼ billions of dollars in state, county and municipally approved water systems and sewage-treatment plants, which will place still greater demands on pump manufacturers.

Where Processes Call For CLOSE CONTROL

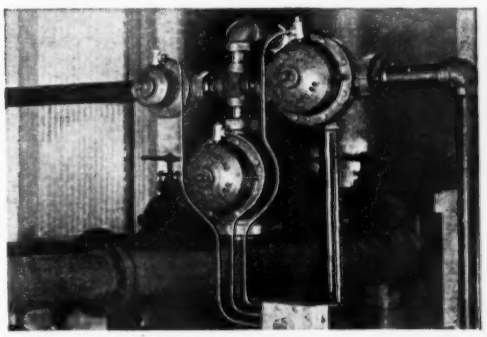
...Industry calls on McALEAR



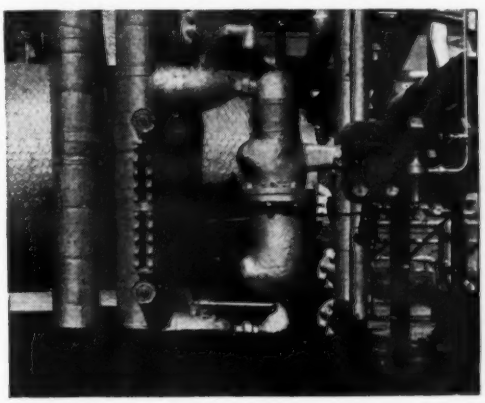
McAlear Type H-86 Motor Diaphragm Valve on gas line in prominent Texas oil company plant.



McAlear M-110 Motor Diaphragm Valve controlling saturated steam pressure to wire rubber-processing machines.



McAlear No. M-1455 Diaphragm Valves controlling flow and rinse cycles in critical industrial operation.



Close-up view of insulated McAlear Type H-850 Liquid Level Control on refinery reboiler.

IN PROCESS INDUSTRIES, particularly, advanced new methods employ abnormally high pressures and temperatures.

These call for new control instruments of greater sturdiness and higher precision—not only to withstand the severe operating conditions—but to give *closer control* of flow, temperature and pressure, where formerly tolerated variations would cause serious losses.

In many leading plants processing high octane gasoline, synthetic rubber, resins, plastics, chemicals, etc.—wherever ruggedness, dependability, high accuracy and low maintenance are prime control requirements—McAlear Controls today are valued for their part in maintaining continuous, uninterrupted production.

BRING YOUR CONTROL PROBLEM TO McALEAR. Draw on the wide experience of McAlear engineers . . . on their readiness and willingness to help you. For informative bulletins or catalog, write McAlear Manufacturing Company, Automatic Control Division of Climax Industries, 1913 South Western Avenue, Chicago 8, Illinois.

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PRESSURE · FLOW · LIQUID LEVEL · TEMPERATURE

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for STEAM, WATER, AIR, OIL—GAS

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HENSZEY *FEED WATER* METER

can really stand up where others fail

The cutting, abrasive action of hot dirty Boiler Blowdown quickly breaks down meters that depend upon close clearances and intricate parts for their accuracy. And that's why the Henszey meter is the choice of so many Power Plant Engineers for the Boiler Blowdown measuring chore.

Henszey Meters stay accurate — stay on the job — accurately measuring Boiler Blowdown, Feed Water, Condensate, Free-running chemicals and other "hard-to-measure" liquids.

For your tough liquid measuring job where stamina with accuracy is required consider a Henszey Meter.

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FEED WATER METERS

Continuous Blowdown • Distillation Systems • Heat Exchangers
Flow Indicators • Boiler Feed Regulators • Proportioning Valves
also MILK EVAPORATORS and PRE-HEATERS

Research Site for Bureau of Mines

Secretary of the Interior Harold L Ickes made public the transfer of a $17,500,000 Army Ordnance Dept plant near Louisiana, Mo., to the Interior Dept for reconversion as a synthetic-liquid-fuels demonstration plant.

Formerly a synthetic-ammonia plant operated for the War Dept by Hercules Powder Co, this site, Ickes states, speeds up Federal synthetic-liquid-fuels research and demonstration. In addition to savings of millions of dollars in construction costs by purchase of this plant, previous experience in England and before that in Germany indicates that operation of synthetic-fuel plants in connection with synthetic-ammonia plants obtains an efficient use of raw materials, plant and personnel.

A nationwide survey of 206 proposed locations in 21 coal-producing states resulted in selection of this site, 100 miles from St. Louis on the Mississippi and within access of the major coal fields in the U. S.

Under the Synthetic Liquid Fuels Act this demonstration plant will operate in conjunction with a research and development laboratory at Bruceton, Pa. Plans call for its use as a proving ground for hydrogenation and gas-synthesis processes developed in the laboratory to supplement limited petroleum reserves with fuels and lubricants extracted from the immense coal beds underlying many of our states. Additional structures and equipment will incorporate the developments of the Bureau's own laboratories with the wartime discoveries confiscated from German scientists.

War Dept Declares Two Plants Surplus

War Dept has declared surplus two of four war-built 30,000-kw floating power plants, one of which will be offered for sale at Antwerp, Belgium, where it has been serving for some time. The second will be offered for sale in this country.

It appeared that the Interior Dept would not claim the unit to be sold here under the priority afforded federal agencies by the Surplus Property Disposal act. Months ago, an Interior sub-division had been interested in purchasing the floating power plant now in use at Jacksonville, Fla.

To be disposed of in Belgium by the Foreign Liquidation Commission is the *Resistance*, which was fitted with a bow and rudder for seagoing purposes and which was converted to operate at 50 cycles. Now in the hands of the Reconstruction Finance Corp at the Philadelphia Navy Yard is the *Seapower*, which also was used in the European theater and returned to this country.

A third floater, the *Impedance*, is now stationed at Manila, and a fourth floating power plant is in use at Jacksonville.

International Nickel Co, Inc, opened a Cincinnati technical section for its development and research division, Dec. 1, 1945. Richard B Kropf, metallurgist, formerly district manager for Copperweld Steel at Hartford, Conn., will be in charge of this section.

Idlers that are seldom idle

At a swift, steady pace—day in and day out —Robins Conveyor Systems carry fuel to power plants without faltering, because they're *Job-Engineered* for reliable, heavy-duty service.

One of the most vital elements of any conveyor system is the design and construction of its idlers. And because idlers must carry the weight of belt and load without excessive maintenance or replacement, Robins idlers are Job-Engineered to insure maximum service at minimum replacement and repair expense. This quality construction is typical of all elements of Robins Conveyors.

You can depend on Robins Conveyor Systems to deliver fuel or other bulk materials —where you want them and when you want them — with smooth, continuous efficiency.

Why not write for complete information on Robins Conveyor Systems. A note or telephone call will bring a qualified Robins *Job-Engineer* to your desk.

AMERICA'S ONLY *COMPLETE* MATERIALS HANDLING SERVICE

Hewitt and Robins unite to offer you 136 years of combined experience in Job-Engineered rubber products and machinery designed to answer every materials handling problem you may have.

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CONVEYORS INCORPORATED

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Salutes

The MAINTENANCE MEN

OF AMERICAN INDUSTRY

● Men who keep the wheels of American industry turning are doing their job in spite of help shortage, scarcity of new and replacement parts and many other difficulties which have taxed their ingenuity.

PATENTS MAKE JOBS

Here at Ajax we get a kick out of knowing that Ajax Flexible Couplings help make their jobs easier by providing positive, resilient drive for direct-connected machines. Phone your nearest Ajax Flexible Coupling representative or write direct for data book.

AJAX FLEXIBLE COUPLING CO. INC.

WESTFIELD, N. Y.

Incorporated 1920

Federal Power Commission, at request of War Production Board, notified 25 public utilities now operating inter-connections that such interconnections must cease during the week of March 15, 1946, unless changes are affected in the status of the operating companies as defined under the Federal Power Act.

Orders for use of these interconnections varied so greatly in establishing a termination date that FPC decided on March 15 as a uniform date for ending such service.

Stephen A Brooks and seven associates have combined to form a new organization with plant and offices at Lansdale, Pa. This group, Brooks Rotameter Co, will manufacture rotameters for flow-rate measurement and control. Its special field of operation will be for difficult services and corrosive atmospheres present in process industries.

H K Ferguson Co, industrial plant designers, engineers and builders, are consolidating their sales and engineering offices at 119 W 57th St, New York. G T MacMillin, eastern div contract manager, will direct sales and preliminary engineering. T K Rothermund, chief district engineer, becomes engineering department head and C A Driver becomes supervisor of all Eastern seaboard and New England construction.

Tube Turns, Inc reports through its president, George O Boomer, that $3,000,000 worth of Defense Plant Corp equipment has been approved by the board of directors for lease from Reconstruction Finance Corp. Purchase of an additional $500,000 of outside equipment has been authorized to round out the company's production facilities.

Curtis-Wright Corp has acquired the Marquette Metal Products Co, Cleveland, O., manufacturers of diesel governors and fuel injectors among other equipment. Herbert Gleitz, president and general manager of the Marquette firm, will continue in that capacity with G W Vaughan, president of Curtis-Wright, assuming the newly created post of chairman of the board.

American Transformer Co, of Newark, N. J., has purchased a tract of land in Union Township, N. J., for a proposed modern manufacturing plant.

Railway Express Agency has announced the issue of an *Air Express Shipping Estimator.* This employs a combination of circular scale to list shipping rates for various weights of airborne freight over specified air miles. A condensed map on the back shows air-line routes between principal cities. Estimator is available without cost upon written request to Railway Express, Dept of Public Relations, 230 Park Ave, New York 17, N. Y.

Booklet, entitled *150 Years of Steel Making,* relates history of Standard Steel Works Div of Baldwin Locomotive Works, Burnham, Pa. Write direct for copy, available upon request.

A new plant, nearly three times as large as its present Detroit plant, has just been acquired by Evans Products Co at Plymouth, Mich. Plant has 330,739 sq ft floor space and is of steel and brick construction.

GESS—ORIGINATORS OF SNUBBING PRINCIPLE FOR QUIETING DIESEL EXHAUSTS—BURGESS—ORIGINA

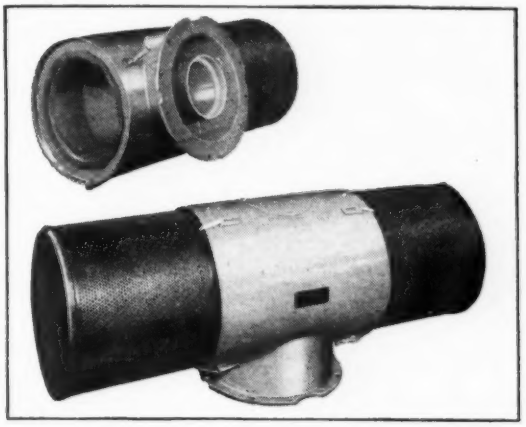
BURGESS SNUBBER BULLETIN for Diesel Exhaust Noise Control

HOW TO *QUIET* AND *CLEAN* TURBOCHARGER AIR INTAKE

For several years, Burgess-Manning has paralleled the development of the turbocharger by designing suitable silencers to quiet the intake whine of the turbocharger blower as it cuts the air at high speed. With the wide experience gained in silencing turbochargers, Burgess-Manning has advanced to the next step—namely, that of designing and producing a Combination Air Intake Cleaner-Silencer for turbochargers. With this unit it is possible to provide effective cleaning and silencing, an accomplishment which heretofore has not been obtained with a single unit.

The Burgess Combination Air Intake Cleaner-Silencer is the same basic design as the standard Burgess Intake Silencer except for changes to accommodate the filter elements (see illustration). This new type can be applied to every exhaust-gas-driven turbocharger. It is an effective silencer, and the cleaner units stop solid particles and foreign matter from entering the engine cylinder to cause scoring. These Burgess Combination Air Intake Cleaner-Silencers are made in 3 sizes to fit the standard Elliott-Buchi turbochargers BF26—BF34—and BF44, and for either engine lubricating or separate blower-type lubricating systems.

The flange mounting of the Burgess Combination Air Intake Cleaner-Silencer is identical to the mounting of the single silencer unit. Maintenance is simplified because the air filters can be removed for cleaning or inspection without shutting down the engine. Two clamps hold the filter in support brackets. A flip of the clamps relieves the tension so that the filter can be removed for servicing.



The Burgess Combination Air Intake Cleaner-Silencer may be used on stationary, marine, or locomotive Diesel engines. The complete unit is of simple, sturdy construction, and can be easily adapted to almost any installation to provide effective double-action cleaning and silencing.

* * *

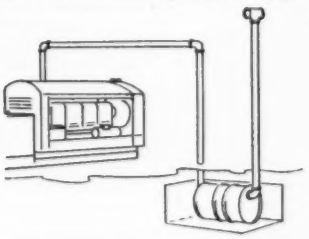
GAS PROCESSING PLANT IS BURGESS SNUBBER-EQUIPPED

The new pressure maintenance and liquid hydrocarbon extraction plant at Haynesville, Louisiana, can process 15,000,000 cu ft of gas per day. The plant extracts gasoline and other hydrocarbons and compresses the residue gas for repressuring to return it to the ground.

An impressive array of Burgess Snubbers on the big compressor engines may be seen installed on the main building.

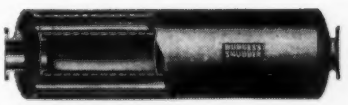
HELPFUL HINTS

The illustration below shows how *not* to install a Diesel exhaust system. The exhaust gases are piped underground to a 55-gallon tank. Such systems may explode if too much fuel or lubricating oil collects in the drum. Whenever trouble develops the makeshift system has to be removed and rebuilt.



How much simpler it would be to install a Burgess Exhaust Snubber and do away with underground tanks and piping! Exhaust noise is entirely prevented and trouble-free service is assured.

BURGESS INDUSTRIAL AIR INTAKE SNUBBER SAI SERIES



The Burgess SAI Industrial Air Intake Snubber does away with air intake noises from Diesel engines, internal combustion engines, compressors, and blowers.

The characteristic "pumping" intake noise is removed by smoothing the flow of intake air into a steady, unidirectional stream. There is no intake restriction to "choke" the engine or compressor.

No tuning of the air intake system is necessary. Therefore, the Burgess Air Intake Snubber may be inserted in any part of the air intake system.

Published by BURGESS-MANNING COMPANY Chicago 18, Illinois

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SS—ORIGINATORS OF SNUBBING PRINCIPLE FOR QUIETING DIESEL EXHAUSTS—BURGESS—ORIGINA
OMPLETE SATISFACTION IN EXHAUST AND INTAKE QUIETING—SPECIFY BURGESS SNUBBERS—FOR COMP

GOT
SLUDGE
TROUBLE?

NCC

Sludge Solvent

CLEANS AND KEEPS CLEAN
Dirty Tanks—Clogged Feed Lines
Clogged Nozzles—Dirty Strainers
Carbonized Pre-Heater Coils
Dirty Burner Tips

DOES NOT HARM METAL

NON-INFLAMMABLE
DOES NOT AFFECT THE FLASH POINT OF OIL

No matter how good your fuel oil is, it will create a sludge deposit.

Sludge follows oil like mud follows rain.. But sludge is a serious nuisance, an expensive nuisance. Its harmful effects start in the tank, whence it is distributed to the feed lines and burner, and are felt right up into production—particularly where temperature control or atmosphere control are important.

Frequent shut-downs to clean sludge-fouled parts are only the beginning of sludge troubles. Neglected, sludge accumulates to the point where parts of the system must even be replaced.

Ridding yourself of sludge is easy and inexpensive. To your next load of fuel, just add NCC SLUDGE SOLVENT, the tested, scientifically prepared fuel oil conditioner. NCC dissipates water and other impurities. NCC liquefies sludge already formed.

Send trial order or write for bulletin, "Management Knows the Facts of LIFE."

NUTMEG CHEMICAL CO.
223 State St., New Haven 10, Conn.

A silver plaque honoring John Cromwell Lincoln as founder of Lincoln Electric Co was presented to him by the firm's employes as a token of their esteem to mark the company's fiftieth anniversary. Lincoln started the concern with a capital of about $150, just 50 years ago in downtown Cleveland.

Rockwell Mfg Co became the new name of the Pittsburgh Equitable Meter Co following the action of the stockholders in approving the board of directors' recommendations. Directors will continue in office under Col Willard F Rockwell, chairman and president, for whom the company is named.

Under the parent Rockwell Mfg Co will be Pittsburgh Equitable Meter Co, Nordstrom Valve Co, Rockwell Machine Co, Edward Valves, Inc, Delta Mfg Co, V & O Press Co, Crescent Machine Co, Rockwell International Corp, and Monessen Foundry and Machine Co.

Philip Carey Mfg Co plans a $5,000,000 plant modernization and expansion program. The over-all program will affect five Carey locations in the U. S. and Canada. Plants included in the program are those at Lockland, Cincinnati, Ohio; Middletown, Ohio; Perth Amboy, N. J.; Plymouth Meeting, Pa.; and Lennoxville, P. Q., Canada.

The American Pulley Co, of Philadelphia, celebrated its fiftieth anniversary recently and issued in honor of the occasion a special golden anniversary issue of its house organ, *The American News.*

Diesel Engine Manufacturers Assn are distributing upon request, addressed to them at 1 N LaSalle St, Chicago 2, Ill., a new booklet, *Diesel Locomotives.* It traces the diesel locomotive since its advent as a "switcher" in 1925 through its acceptance as a passenger locomotive in 1934, to its present prominence in railroading. Industrial diesel locomotives as used by industry and those special "off the line" applications in railroads are also discussed.

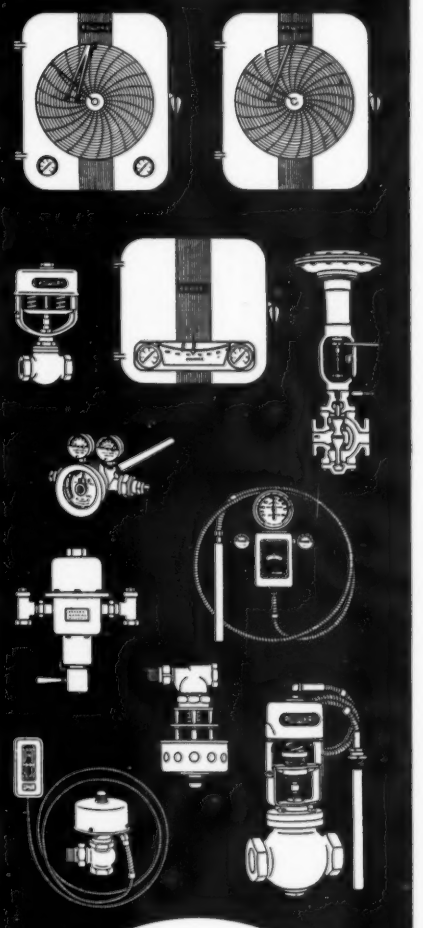
Allied Control Co, Inc announced through its president, E H Gillette, the acquisition of B F Miller Co, transformer manufacturers.

Naval commander George Gellhorn resumes his post as export manager with Worthington Pump and Machinery Corp following his release from the U. S. Navy.

San Diego Gas & Electric Co announces approval of its plans to spend $5,000,000 for purchase and installation of a 50,000-kw steam-electric generator that will be the largest on the company system. The generator will be installed in an addition to be built on Silver Gate Station completed in 1943. Officials estimate that 20 months will be required for completion of project.

Wabash Appliance Corp merged with Wabash Photolamp Corp and Birdseye Electric Corp Jan 1, 1946, to become a wholly owned but independently operated subsidiary of Sylvania Electric Products Inc. A M Parker remains as president and general manager of Wabash, with headquarters at Brooklyn, N. Y. Sales staffs, sales policies, product brands and distribution outlets remain unchanged.

POWERS
TEMPERATURE and HUMIDITY
CONTROL

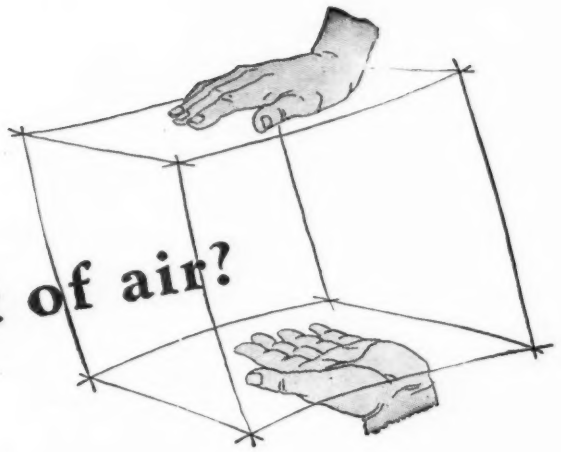


When you want accurate and dependable automatic temperature or humidity control for Industrial Processes, Heating or Air Conditioning Systems, call in a Powers engineer. With over 50 years of experience and a very complete line of self-operating and air operated controls we are well equipped to fill your requirements.

Write for Circular 2520
2771 Greenview Ave., Chicago
Offices in 47 Cities—See your phone directory.

THE POWERS REGULATOR CO.

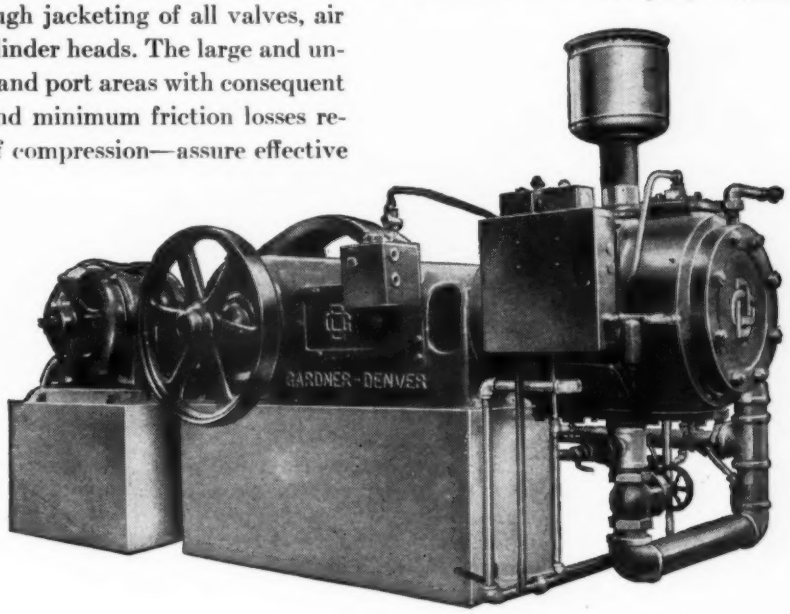
How much will it cost YOU to "squeeze" a foot of air?



Any air compressor will "squeeze" air for you. But how well will that job be done—how much power will it take to compress a cubic foot of air to the pressure you require?

The cylinder design of your compressor has a lot to do with that question. In the Gardner-Denver "RX" Horizontal Compressor, for example, the cylinders are of advanced design to provide higher volumetric efficiency and lower horsepower requirements. The air valves are located radially at each end of the cylinder to permit thorough jacketing of all valves, air passages and cylinder heads. The large and unrestricted valve and port areas with consequent low velocities and minimum friction losses reduce the heat of compression—assure effective lubrication. Add it up—it means *lower cost.*

Better cylinder design is only one of the many outstanding features of the Gardner-Denver "RX" Compressor. Let us tell you why "RX" compressors have made a name for themselves in industry—for full facts, write Gardner-Denver Company, Quincy, Illinois.



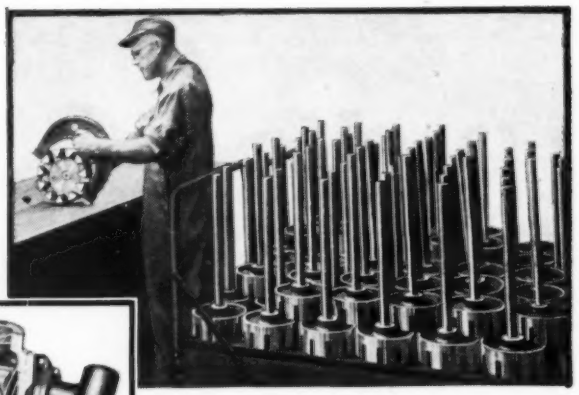
Gardner-Denver "RX" Horizontal Single Stage Compressor—capacities from 89 to 1292 cu. ft. displacement per minute.

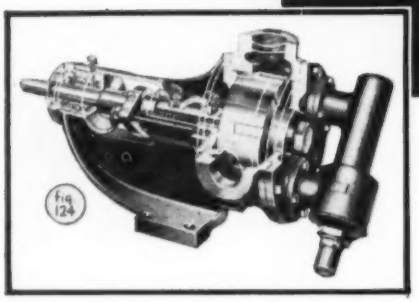
GARDNER-DENVER

Since 1859

- No compressor is better than its valves—and in the "RX" compressor, Gardner-Denver duo-plate cushioned valves provide high compression efficiencies with lowest power consumption. These valves are "air cushioned" for long life.
- Rugged main frame is completely oil and dust-tight, yet provides easy access to all working parts.
- The entire lubricating system is positive, automatic and foolproof.
- Timken adjustable double row tapered roller bearings on crankshaft provide considerable overload capacity with consequent long life.

VIKING Says "NO"





So You Will Say "YES"

In spite of the rush of producing pumps for rebuilding industry on a peace-time basis, Viking still knows how to say "No" when it comes to manufacturing rotary pumps.

All parts undergo rigid inspection to insure that pre-war standards of quality are maintained. There is no sacrifice of quality. When Viking says "No" to parts coming through the line it's you they are thinking of and it's you who will continue to say "Yes". Viking is a pump that places quality above everything else.

Write for free Bulletin Series 46SW today. It will give you the latest information on Viking rotary pumps.

See Our Catalog In SWEETS

VIKING PUMP COMPANY
CEDAR FALLS, IOWA

5,000 Refrig. Food Lockers

This COMMUNITY REFRIGERATION CENTER Serves Over 15,000 Customers

10,000 Furs in Storage

48,000 Cu. Ft. Freezer Storage

Pat Denham's model plant, covering an entire block at Oklahoma City, provides ten distinct services: it has the world's largest food-locker system, safekeeps 10,000 furs, operates a general freezer storage, makes crystal-clear ice, processes all kinds of foods, does quick-freezing, sells frozen foods, runs a restaurant, has a gas station, and includes a big laundry. Frick refrigerating, ice-making, and air conditioning equipment carries all the cooling loads.

Bulletin 126 tells how any town or city can profit from a similar COMMUNITY REFRIGERATION CENTER. Write for your copy now.

FRICK COMPANY, Waynesboro, Pa.

14-Ton Ice-Making System

Air Conditioned Sales Room

Restaurant Service

APPOINTMENTS

Appointment of Charles N Karr to position of sales promotion manager of tractor div is announced by **Allis-Chalmers Mfg Co.** Mr Karr succeeds E L Aikins, who was recently placed in charge of company's tractor div, Seattle, Wash., office. William H Knight has resigned as manager of Duluth, Minn., branch sales office. He will be succeeded as manager by John G Barta of Milwaukee district office. Ralph A Powers has been named engineer in charge of electronic engrg.

Baldwin Locomotive Works elects Robert G Allen general sales manager.

James F Collins, Statler Bldg, Boston 16, Mass., has been made field engineer and sales representative for **Ajax Flexible Coupling Co.**

Plibrico Jointless Firebrick Co, Chicago, Ill., announces appointment of Joseph T Smith as manager of Plibrico Sales & Service Co, 1365 Wyoming Ave, Scranton, Pa. Mr Smith will act as distributor of Plibrico refractory products.

A W Gilmore has been made assistant to C R Pritchard, general sales manager of **General Electric Co's** appliance and merchandise dept. He will assist Mr Pritchard with sales of GE construction materials.

Chicago office of **Babcock & Wilcox Co** and Babcock & Wilcox Tube Co announce removal of their offices to 105 S La Salle St.

John L Defandorf has been elected general engineering supervisor over rubber mill, synchronous motor, valve control, public works, short orders, textile, paper and printing equipment divisions for **Cutler-Hammer.**

Yarnall-Waring Co made following personnel changes at home office and factory: (1) Joseph Kildare has been appointed sales manager. (2) Frank W Miller has been made works manager. (3) J Frank Long has been transferred to Chicago district office as sales engineer. (4) Charles H Grosjean is now in charge of Detroit sales office, replacing C N Maxfield, who has been appointed California district manager, with new sales offices in San Francisco and Los Angeles. (5) Jackson Kemper has been added to sales staff of New York office. (6) Jack Schuyler has joined sales staff of Los Angeles office.

Westinghouse Electric Corp announces transfer of aviation section activities from industrial sales dept to marine sales dept, headed by C H Weaver. Dept will now be known as marine and aviation sales dept. A. L. Paquette has been made manager of aviation section. Robert C Dunson becomes product supervisor of laundry equipment dept of electric appliance div.

Westinghouse electric appliance div also announces following advertising appointments: (1) J R Clemens, assistant manager of appliance advertising, who will have responsibility of product advertising, promotion and sales training (2) P W Endriss, assistant

TERRY

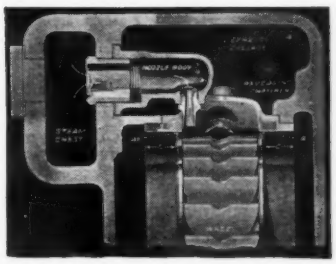
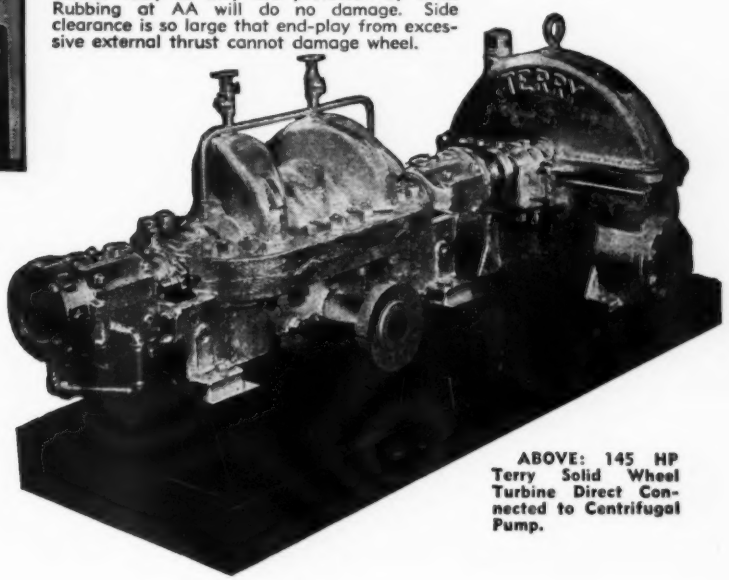


DIAGRAM SHOWING WHEEL CLEARANCES.
AA—Rim clearance, B—Large blade clearance, CC—Side clearance, (about one inch). Blades cannot foul, as they are protected by rims. Rubbing at AA will do no damage. Side clearance is so large that end-play from excessive external thrust cannot damage wheel.



ABOVE: 145 HP Terry Solid Wheel Turbine Direct Connected to Centrifugal Pump.

THESE LARGE WHEEL CLEARANCES INCREASE TERRY TURBINE DEPENDABILITY

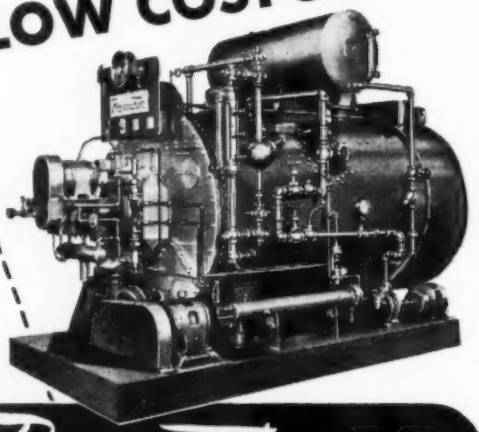
In the Terry Wheel Turbine fine blade clearance is not essential to high operating efficiency. The actual clearance between the moving and stationary blades is greater than ⅛ inch. End play cannot affect this clearance and the side clearance is one inch or more. It is therefore not essential to make frequent adjustments of the thrust to maintain efficient and safe operation.

Clearance in the Terry blading may be reduced only by excessive wear of the main bearings, but even if this should occur, the projecting rims on the side of the wheel would rub on the smooth protecting surfaces of the reversing chamber, thereby automatically stopping the turbine before damage could result. Replacement of the interchangeable bearings immediately restores the original clearance.

T-1158

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

HOW TO GET FAST LOW COST STEAM



Powermaster*
AUTOMATIC OIL-BURNING
STEAM GENERATING UNIT

- **"PACKAGED" UNIT!** Boiler, oil burner, condensate return system and automatic controls are *built-in*—ready to use when delivered.
- **SAVES FUEL!** Usable hot condensate returned to boiler means low fuel cost. So does the unit's high thermal efficiency.
- **NO STACK NEEDED** for draft! Operates on forced-draft principle. Small vent carries off combustion gases.
- **QUICKLY INSTALLED!** No special foundation needed. Just make necessary service connections and it's ready to go.
- **FULLY AUTOMATIC!** No stoking. No constant attention to valves, gauges and controls. Clean. Compact. Complete!

• Fast, automatic steaming is one of the Powermaster's outstanding features. Flick the switch and you have full steam pressure in as little as 18 minutes.

GET BULLETIN #1213 for full information — write to Orr & Sembower, Inc., 892 Morgantown Road, Reading, Pa.

*T. M. Reg. U. S. Pat. Off.

ORR & SEMBOWER INC.

READING O&S PENNA.

Builders of Better Boilers Since 1885

manager of appliance advertising, who will handle full line advertising programs, consumer education and advertising and promotion of insecticide dispensers (3) E J Hegarty, manager of sales training, with responsibility for development, production and testing of wholesale and retail sales training plans (4) K A Donelson, operations manager, who will be responsible for budgets, administering Westinghouse cooperative advertising and who will act as office manager of advertising dept (5) J G Baird, sales promotion manager, who will be responsible for full line sales promotional activities for department and furniture stores and who will continue in charge of Westinghouse store modernization activities, exhibit and convention work, and consumer film programs.

Westinghouse Electric Corp names H Norman Miller manager in Portland area. He succeeds L G Fear who will act as company's special representative in both Seattle and Portland areas to better coordinate Westinghouse activities throughout entire Pacific Northwest and Alaska. J H Cox has been appointed engineering manager of Pacific Coast manufacturing and repair div at Emeryville, Calif.

John A Schoch has been named manager of transportation sales dept of **Westinghouse**, succeeding H H Chapman who has been transferred to Northwestern district. E R Nary has been made assistant to Vice-President Walter Evans, with broad responsibilities for operation of industrial electronics and X-ray divisions at Baltimore, Md., and home radio division at Sunbury, Pa. Orland H Yoxsimer becomes manager of household refrigerator cabinet engineering div. Neil C Reed has been appointed manager of district operations of elevator div.

Appointments of a manager and two supervisors in field of student training have been announced by educational dept of **Westinghouse Electric Corp:** Henry N Muller Jr became manager of graduate student training; Maynard J Warneke, supervisor of training; and Albert J Murphy Jr, supervisor of student activities.

Westinghouse Electric Supply Co appoints Charles B Kennedy branch manager at Dayton, O.

Hawaiian Electric Co, Ltd, announces appointment of Lyndon W Clifford as electrical sales development counselor. Mr Clifford has had 22-years experience in electrical sales development with Westinghouse Electric Corp.

Combustion Engineering Co announces appointment of Constructor Co, 786 Eustis St, St. Paul, Minn., as sales agent for Minn., N. D., S. D. and bordering territory in Wis. and Iowa. George B Cunningham has joined sales organization of Combustion Engineering and has been assigned to Birmingham, Ala., district.

H E Loeffler has organized the **Stimax Trading Corp,** Leesburg, Va. (near Washington, D. C.) and will soon travel to Europe as a representative of various American

On this completely rebuilt heavy duty shaper at the Krautter-Weber Tool Works, the use of Veelos V-belt provided the following engineering advantages: 1. Eliminated overhead motor and overhead belt drive. 2. Provided better speed control...old drives had only one speed forward and return. 3. Ended noise and excessive vibration.

WHEN the Krautter-Weber Tool Works, Newark, N. J., decided to modernize this heavy duty shaper—built many years ago—it specified Veelos link V-belt on four vital drives. Efficient speed control was a "must"—and, in selecting Veelos, Krautter-Weber chose the belt that helps hold machine speeds at desired rates *by providing uniform belt tension and by eliminating belt slippage:*

1. Veelos Provides Uniform Belt Tension: Veelos patented link construction permits easy adjustment so that each strand of a multiple V-drive carries its exact share of the load. All strands constantly work together, delivering full power.

2. Veelos Ends Slippage: Quick, easy adjustment of Veelos ends belt slippage . . . keeps machinery running at full speed and assures full productivity.

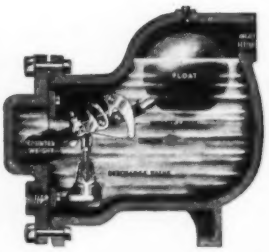
To modernize old equipment . . . to assure maximum service on new equipment . . . to replace V-belts on any equipment . . . specify Veelos. A Veelos engineer will gladly assist you—just write and arrange an interview.

VEELOS
THE LINK
V-BELT
Adjustable to any Length
Adaptable to any Drive

MANHEIM MANUFACTURING & BELTING COMPANY
MANHEIM, PA.

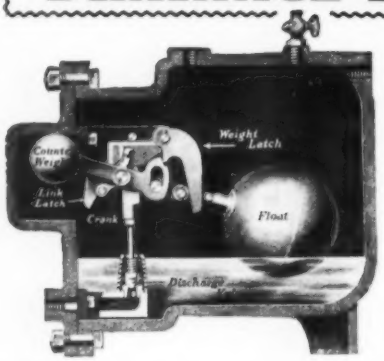
LINK CONSTRUCTION UPS PRODUCTION

NICHOLSON
WEIGHT-OPERATED
TRAPS



offer

OUTSTANDING RECORDS
FOR
DRAINAGE EFFICIENCY



These plant-proved units feature enormous drainage capacity, fast positive action, stainless steel where it counts, and sturdy construction to take the abuse of toughest applications. On their on-the-job records, you can depend solidly on Nicholson Traps to promote efficiency. For every power and process purpose.

Catalog 444 or See Sweet's

W. H. NICHOLSON & CO.
125 Oregon St., Wilkes-Barre, Pa.

ALSO THERMOSTATIC, AND PISTON-OPERATED TRAPS FOR STEAM, AIR, GASOLINE

FLANGE JACKS

...eliminate costly gasket replacement shut-downs!

An ingenious tool for opening pipe flanges for gasket renewal — quickly, easily and safely. FLANGE JACKS eliminate hazardous hammer and chisel methods and prevent damage to flange faces. Openings are smoothly made against great pressures, yet flanges are held in perfect alignment. FLANGE JACKS save time, reduce accidents . . . make *better* seals possible.

WRITE FOR LITERATURE
WRITE DEPT. E. FOR DETAILS OR SEE YOUR NEAREST DISTRIBUTOR.

MAXIMUM PROTECTION
to personnel and plant!

FLANGE JACKS are vital when replacing gaskets in presence of oil or gas fumes . . . eliminates hammer blows and sparks. FLANGE JACKS are a "must" in safety engineer specifications.

T. G. PERSSON COMPANY
224 GLENWOOD AVE., BLOOMFIELD, NEW JERSEY

firms and products in fields of machinery and materials. Dr. Loeffler was formerly connected with **Loeffler** high-pressure boiler interests in Europe and has many connections abroad.

Harry McCool has been appointed sales engineer for steel and tube div of **Timken Roller Bearing Co** in Cincinnati district, which includes Ind., Ky. and part of O. Fred Reiser Jr has been named division manager for all divisions in Cincinnati.

Hewitt Rubber Corp elects Gerald J Slade advertising manager. LaFrance Industries, Philadelphia, has been named as sales agent for Hewitt's *Restfoam* (latex foam) products to furniture manufacturers and upholstering trade.

W S Mounce has joined the development and research div of **International Nickel Co.** John G Dean is now with development and research div as Senior Fellow-in-Absentia of Mellon Institute of Industrial Research, Pittsburgh, Pa.

Leslie Co announces appointment of following agents to handle industrial sales and service: J N Fehlinger, New York City, N. Y. and vicinity; Frank Howell Co, Richmond, Va., state of Virginia; John Zimmerman, Louisville, Ky., state of Ky.; Bruce Greaves Co, St. Louis, Mo., eastern Mo and southwestern Ill.

To coordinate export activities of various subsidiaries and divisions of **Rockwell Mfg Co**, Rockwell International Corp, with offices in Empire State Bldg, New York, N. Y., has been organized. Under active direction of A L DiGiulian, Rockwell International Corp will conduct export sales for Pittsburgh Equitable Meter Co, Nordstrom Valve Co, Edward Valves, Inc, and establish export sales policies for Delta Mfg Co, V & O Press Co and Crescent Machine Co, all subsidiaries of Rockwell Mfg Co. In addition, Rockwell International Corp will handle export sales for several independent companies.

Edward Valve & Mfg Co has been renamed **Edward Valves, Inc.** Company is a subsidiary of Rockwell Mfg Co. No change in personnel or sales policies are planned.

H A Smith Machine Co has been renamed **Rockwell Machine Co.** This company supplies precision machined parts to other subsidiaries and divisions of Rockwell Mfg Co. Herbert S Rockwell continues as director of operations at Hopewell plant.

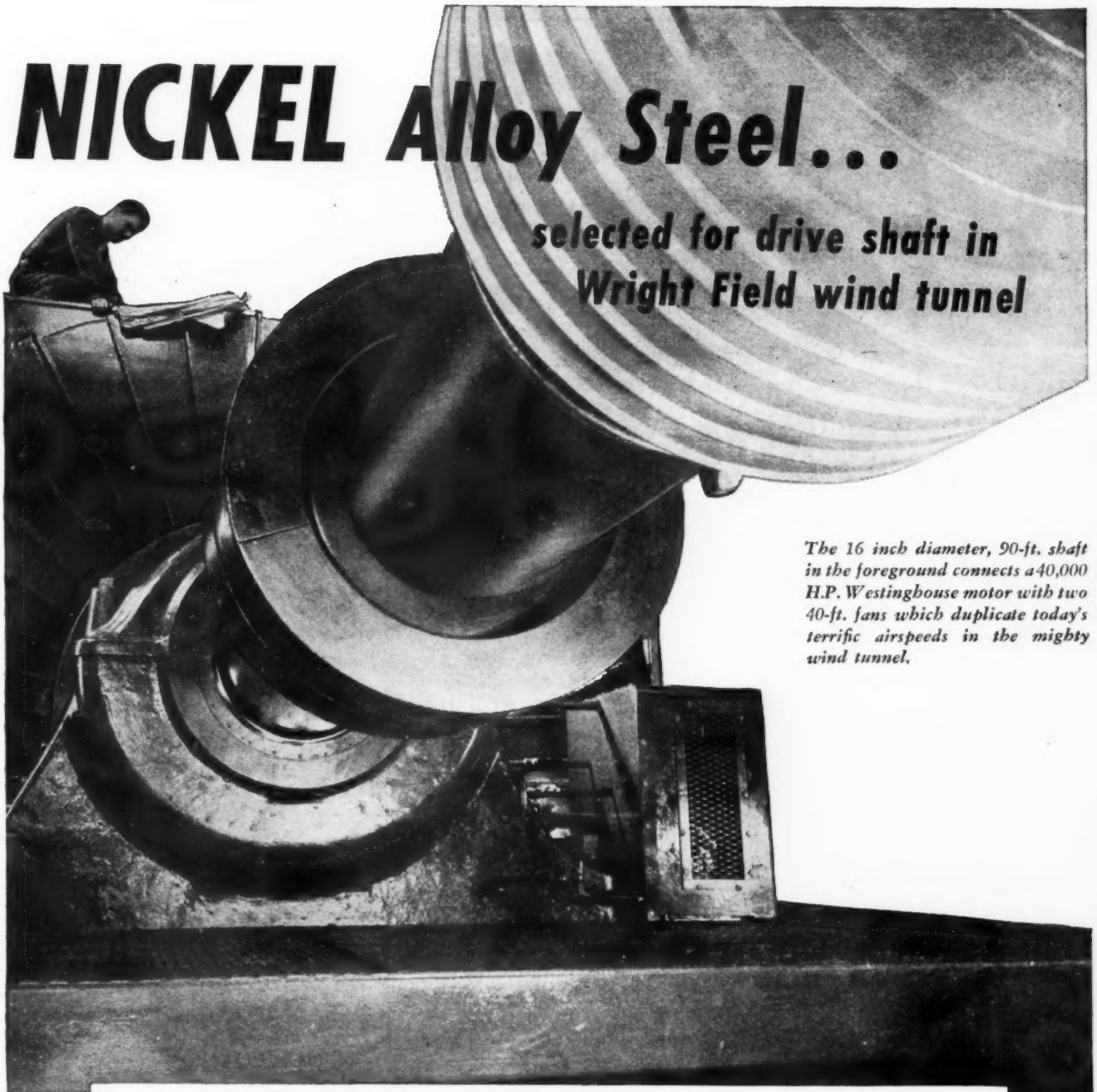
Lewis F Bacon and Henry S Morse retired as plant superintendent and planning engineer in charge of design, respectively, at **Monsanto Chemical Co's** East Side plant.

Helicoid gage div of **American Chain & Cable Co** has been moved from Long Island City, N. Y., to Bridgeport, Conn., where sales, engineering and manufacturing departments will be located.

Appointment of Dr Lester L Hirst as acting chief of a new hydrogenation demonstration plant which **Bureau of Mines** will establish at Missouri Ordnance Works near Louisiana,

NICKEL Alloy Steel...

selected for drive shaft in Wright Field wind tunnel



The 16 inch diameter, 90-ft. shaft in the foreground connects a 40,000 H.P. Westinghouse motor with two 40-ft. fans which duplicate today's terrific airspeeds in the mighty wind tunnel.

The high mechanical properties required for this large drive shaft were specified by Westinghouse Electric Co., Inc., suppliers of the wind tunnel motor and auxiliary equipment.

To meet the specifications, a Nickel-molybdenum steel was selected.

Significant are test results on bars from prolongations of the forgings, after normalizing and tempering:—

Ultimate tensile strength	117,500 p.s.i.
Yield Point	90,500 p.s.i.
Elongation in 2"	20.0 %
Reduction in Area	55.4 %

We invite inquiries on the uses and selection of Nickel alloy steels, and other Nickel alloys.

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N. Y.

. . . FOR THOSE BIG JOBS

NATIONAL AIROIL BURNERS
for FUEL OIL
. . . for GAS

TYPE SAL

A LARGE CAPACITY OIL BURNER . . . FOR FIRING LARGE BOILERS

Here is a steam atomizing oil burner that will turn 600 gallons of heavy fuel oil into 90,000,000 B.T.U. liberation *every* hour. This burner, our Type SAL, is giving efficient service with large boilers in many refineries and chemical plants. In open hearth furnaces, cement kilns and dryers, the Type SAL has a record of top performance; it is also readily adaptable for use in combination with powdered coal, coke or natural gas in boilers of the largest size.

Either steam or compressed air or fuel gas may be used for atomization. Only occasional cleaning and a minimum of maintenance is necessary to keep the Type SAL burner in first class condition.

Let us apply our nearly 35 years' experience in the design and manufacture of fuel oil and gas burner equipment to the solution of your combustion problems.

SIGN AND MAIL THE COUPON. Our bulletin 24 with detailed description of the Type SAL will be sent for your files.

NATIONAL AIROIL BURNER

National Airoil Burner Company, Inc.
1250 East Sedgley Avenue
Philadelphia 34, Pa.

Gentlemen:

Please send me your bulletin with complete information on the Type SAL Oil Burner.

FIRM .....
ADDRESS .....
CITY ..... STATE .....
NAME ..... TITLE .....

NATIONAL AIROIL BURNER Company, Incorporated

1250 EAST SEDGLEY AVENUE, PHILADELPHIA 34, PENNA.

Texas Office: 2nd National Bank Bldg., Houston

OIL BURNERS • GAS BURNERS • GAS PILOTS • PUMP SETS • EXPLOSION DOORS
ACCESS DOORS • AIR DOORS • BURNER BLOCKS • FURNACE OBSERVATION WINDOWS

Mo., was announced. Other appointments to hydrogenation plant included D S Taylor as chief of plant maintenance and J A Markovits as second assistant to Dr Hirst.

Link-Belt Co announces that Joseph W Sears has been appointed district sales manager with headquarters at 711 Main St, Houston. Stuart Penick has been made district sales engineer at Dallas, to fill vacancy created by Mr Sears' transfer to Houston.

B A Springer has become a sales engineer for **Baldwin Locomotive Works.**

Elliott Co appoints Bingham H Van Dyke manager of new products dept.

Iron Fireman Mfg Co has announced election of A M Stephenson and A Bayes Jordan as district representatives in southern territory.

James C Barnaby has been transferred to general engineering staff at Harrison Works of **Worthington Pump & Machinery Corp** as assistant director of research and development.

A C Nydegger, who has been on active duty in the Navy, returned to Milwaukee office of **Blackmer Pump Co** as manager.

C L Hancock has been promoted to manager of technical service dept of **Bridgeport Brass Co,** with headquarters in main office at Bridgeport, Conn.

Fuller Co announces removal of its Chicago district office to 120 S La Salle St. C C Kaesemeyer is the manager in charge.

Appointment of J J Smiley Jr as assistant advertising manager of **Philip Carey Mfg Co** was announced. Clarence M Allen was made branch manager of St. Louis office.

C F Johnson has joined **Watson-Stillman Co,** Roselle, N. J., where he is in charge of all engineering in forged steel fitting and bronze and forged steel valve divisions. He will also function as a Watson-Stillman representative in contacting the trade.

A K Granrud has been made district representative of **Saverite Engrg Co** at the Pacific Coast.

Power piping div of **Blaw-Knox Co** announces appointment of Flagg, Brackett and Durgin, Boston, Mass., as sales representatives in Mass., Me., N. H., Vt. and R. I.

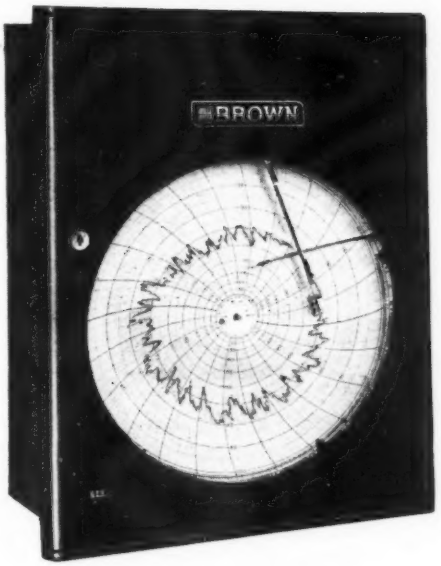
H C Stark will be manager of new branch sales office of **Square D Co** at 1060 Broad St, Newark, N. J. H W Wharton will be field engineer for the office. The new branch will handle all company activities for the N. J. territory north of Monmouth County which were formerly served from New York branch.

Philadelphia Gear Works recently made following appointments: (1) Leroy L Handy, 6932 Cass Ave, Detroit 2, Mich., will represent them in Detroit area on all prod-

How Many Fuel Dollars Do You BURN?

FUEL is money. Unless you *know* how much steam is produced and used at all times, you are burning fuel dollars needlessly . . . wastefully.

With Brown Flow Meters, you can correctly determine the cost of making steam for power, processing or heating and properly allocate costs to departments or units. Brown Flow Meter chart records reveal instantly any deviation above or below the most efficient operating standards of steam generation and distribution.



Brown Electric Recording Integrating Flow Meter

Thousands of steam engineers are getting this kind of service from Brown Flow Meters. They are easy to install—parts are simple and few. In many plants, the investment for Brown Flow Meters has been repaid many times over. Learn more about them. Write for Catalog No. 2008.

THE BROWN INSTRUMENT COMPANY, a division of Minneapolis-Honeywell Regulator Company, 4490 Wayne Avenue, Philadelphia 44, Pa. Offices in all principal cities. Toronto, Canada; London, England; Stockholm, Sweden; Amsterdam, Holland.

BROWN FLOW METERS

. . . MINNEAPOLIS-HONEYWELL CONTROL SYSTEMS . . .

Type DA-31 Pressure Control

MERCURY SWITCH
Hermetically sealed mercury switch is used. They cannot be affected by dust, dirt or corrosion; nor are they subject to open arcing, oxidation, pitting or sticking of contacts, all common causes of contact trouble. This switch will give better control service and longer control life.

BOURDON TUBE
(Hidden back of cover)
The Bourdon tube is the actuating element of the control. It is the oldest known, tried and proven element, having been used in gauges for many years.

OUTSIDE ADJUSTMENT
The outside double adjustment with the calibrated dial and pointers is a convenient feature, making it very easy to set the required operating range, plainly visible on the dial. All guesswork is eliminated.

GLASS FACE
The glass face on the cover permits seeing the entire operation of the control in plain view. One can always tell whether the switch circuit is open or closed, a great convenience whenever servicing becomes necessary.

Consult Mercoid on pressure, temperature, liquid level or automatic mechanical control problems.

THE MERCOID CORPORATION
4201 Belmont Avenue
Chicago 41, Illinois

THE ASSURANCE OF DEPENDABLE SERVICE BUILT IN EVERY MERCOID CONTROL

ucts including *Limitorque* valve controls. (2) Atwood Machinery Co, 931 Santa Fe Ave, Los Angeles 21, Calif., will represent them in southern Calif on everything except *Limitorque* valve controls.

Announcement is made of formation of **Perfect-Line Mfg Corp,** Hicksville, N. Y., manufacturers of a wide range of electrical equipment and specialties. At the helm of the new company is Alfred Robbins, its president and chief engineer. John M Goettleman has been named plant superintendent.

Paul L Goldstrohm is now general manager of **Lewis Pump Co,** Philadelphia, Pa., factory representative in Pa., Md., N. J. and Del. territories for pump div of Geo D Roper Corp.

Richard G Newton, recently discharged from U. S. Coast Guard, has returned to **Rockbestos Products Corp.** He resumed his former duties as sales representative in New England territory, with headquarters at main office in New Haven, Conn.

Horace A Deane, works manager of Brake Shoe and Castings Div of **American Brake Shoe Co,** has been appointed a vice-president of the div. Joseph B Terbell has been made executive vice-president of American Manganese Steel Div. Irving F Wagner became a vice-president of Kellogg Div.

Victor L Persbacker was elected assistant controller of **American Brake Shoe Co,** Canadian Ramapo Iron Works, Ltd, and Dominion Brake Shoe Co, Ltd.

Gordon M Colwill took over duties of supply sales manager for **Graybar Electric Co** at executive headquarters in Graybar Bldg, New York City.

DeLaval Steam Turbine Co appointed Palen Flagler director of advertising and publicity. He will make his headquarters in Trenton, N. J. Geo H Gibson Co, New York City, continues to handle the advertising account.

Johnson Service Co announced election of Maxwell F Rather as a vice-president. In his new capacity, he will continue his work in New York as manager of the Eastern district and of the export div.

John W Mock has been appointed sales manager of **Protectoseal Co,** Chicago 8, Ill.

A M Byers Co established a divisional office at Atlanta to serve Ga., N. and S. Car., Fla., Ala. and parts of Tenn. James A Cain has been made manager of the new div. His headquarters will be at 817 William Oliver Bldg, Atlanta.

Harold F Marshall has returned to his desk with **Warren Webster & Co** after 3½ years service with Army Air Corps. Before his assignment to active duty in World War II Mr Marshall headed the Webster advertising dept for 18 years, a position which he now resumes. In addition to his advertising duties Marshall will be concerned with all the broader phases of the company's domestic and export sales developments. Ben F Lerch,

Here's how ARMOR-CLAD (MONOLITHIC COATING) eliminates costly furnace relining shutdowns!

EASY TO APPLY—NO SPECIAL SKILL OR TRAINING IS REQUIRED.

Scientific investigation and operating experience prove refractory wall failure does not result from the action of excessive temperature. Instead, slag adhesion, and the penetration of flame, slag, hot gases, and unburned fuel through joints, pores and cracks in refractory lining, are the chief causes. ARMOR-CLAD provides an impenetrable, vitreous, high-glaze protective coating of unbroken extent over refractory linings. Pores, joints and impingement areas are seamless-sealed and adhesion or penetration effectively prevented. Refractory lining life is increased.

Write on company letterhead today for ARMOR-CLAD literature. Complete, detailed information is contained therein; no obligation of course.

ARMOR-CLAD COMPANY
Refractory Protection
39 HYATT AVE., NEWARK 5, N. J.

FOUR hundred years ago, an enemy invaded the North American continent. A little band of Spaniards, encased in steel armor and equipped with steel weapons, quickly overran the country now called Mexico, slaughtered thousands of defenseless Aztecs, and enslaved the Kingdom of Montezuma.

Although the soil was impregnated with iron and large masses of it were scattered over the surface of the tableland, the natives did not know how to smelt the ore or work the metal. Today, the descendants of these vanquished Americans, still ignorant of steel, wander amidst jungle-choked ruins of cities without even a racial memory of their people's former greatness. Well may we term this vast, strange pyramid, recently excavated at Chichen Itza, a 'Monument to a Lost Kingdom'.

Twice in our time, would-be invaders have failed to conquer America. Italy, Germany, and Japan have lost. So once again it is proved conclusively that to win a war a nation must have or achieve superiority in the use of steel.

Steel can prevent wars as well as win them. In self protection, America must maintain her pre-eminence in steel, must employ it for permanent peace. To that end, Youngstown, who produces a large percentage of America's steel, is ready to supply it...in wanted forms and formulae ...to industry, to build new and improved products, thus to provide jobs, eliminate want and disease, insecurity and fear, and so advance peace and well-being throughout the world.

QUALITY YOUNGSTOWN SERVICE

YOUNGSTOWN

THE YOUNGSTOWN SHEET AND TUBE COMPANY

YOUNGSTOWN 1, OHIO

Export Office . . . 500 Fifth Ave., New York

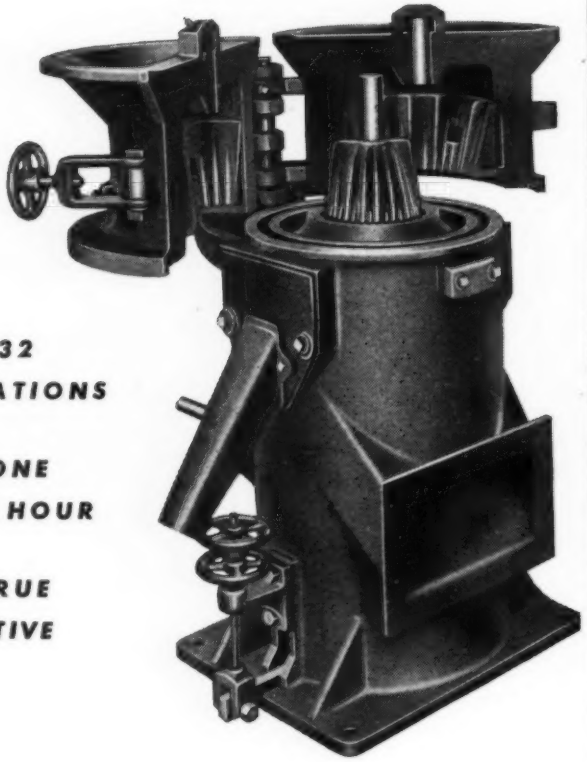
Manufacturers of

CARBON · ALLOY AND YOLOY STEELS

Pipe and Tubular Products-Sheets-Plates-Conduit-Bars-Electrolytic Tin Plate-Coke Tin Plate-Rods-Wire-Nails-Tie Plates and Spikes

YOU GET ACCURATE COAL SAMPLES FAST WITH STURTEVANT

Automatic Crusher and Sampler



★ ELIMINATES 32 HAND OPERATIONS

★ PROCESSES ONE TON IN ONE HOUR

★ PROVIDES TRUE REPRESENTATIVE SAMPLES

The Sturtevant automatic coal sampler enables you to make accurate coal samples quickly and easily. All you do is feed the coal or coke into the hopper . . . the sampler does the rest, discharging a homogeneously representative mixture through the sample spout ready for analysis.

The Sturtevant method eliminates 32 of 34 hand operations, thus speeds sampling work and cutting costs by providing accurate samples in a few minutes. Get the Sturtevant story. Write for information and bulletin today.

STURTEVANT MILL COMPANY

33 Harrison Square, Boston 22, Massachusetts

Designers and Manufacturers of

CRUSHERS • GRINDERS • SEPARATORS • CONVEYORS
MECHANICAL DENS and EXCAVATORS • ELEVATORS • MIXERS

who handled Webster's advertising during Marshall's absence, will now devote his full time to division manager, standard equipment sales. L H Plum is division manager of control system sales, and D F Bennett division manager of radiation and unit heater sales.

F H Hoge was elected president of **W A Jones Foundry and Machine Co,** succeeding William Coleman who resigned.

Concurrently with formation of a sales development dept to integrate and intensify product application and new development activities, **Allegheny Ludlum Steel Corp announces appointment of** W B Pierce to head the dept. Under his direction, a staff of technically trained engineers will assist manufacturers in solution of problems involving applications of stainless steel and related alloys.

H B Axtell has joined with V A Chern to represent **Progressive Welder Co** in the **Eastern district.** Messrs Axtell and Chern have established offices at 15 Gramercy Park S, New York 3, N. Y.

Carl J Dinic has been appointed executive assistant to the president, D W Fraser, of **American Locomotive Co.**

Ajax Flexible Coupling Co made R R Bauman their Chicago area sales representative. Mr. Bauman's address is 407 S Dearborn St, Chicago.

After nearly four years of military service, Lt Col Bern Dibner returns to his civilian post at the helm of **Burndy Engineering Co,** New York, the company he founded in 1924 for manufacture of electrical connectors.

Bryant Heater Co established an industrial div to handle development and distribution of gas combustion components for industrial and process equipment. The industrial div is under direction of Donald A Campbell.

Bryant Heater Co appointed Robert M Buck and Robert A Clark to development staff of industrial div.

Willis Engineering Co, Ohio distributors for Briggs Clarifier Co oil filtration products (industrial), moved their general offices from Burton, Ohio, to 206 Plymouth Bldg, Cleveland.

Charles S. Cheston was elected to board of directors of **Monsanto Chemical Co.**

Manhattan Rubber Mfg Div of Raybestos-Manhattan, Inc, appointed John B Anderson assistant manager of Central District, with headquarters at Pittsburgh, to succeed the late Stanley J Waechter. This territory has been expanded to include a large portion of O., eastern panhandle of W. Va., and several northern counties of Md. Joseph Hoffman will represent the company in southern Pa. and northern W. Va.

John S Lawrence has been made district sales manager of Denver branch, mechanical goods div, **United States Rubber Co.** This territory was formerly under the tentative

One of a series of advertisements, each discussing trapping practice on a different class of equipment.

HOW TO TRAP STEAM PURIFIERS AND SEPARATORS

to eliminate dangerous slugs of water by quick, complete drainage

• Piston-operated compound trap with capacities to 300,000 lbs. per hr.

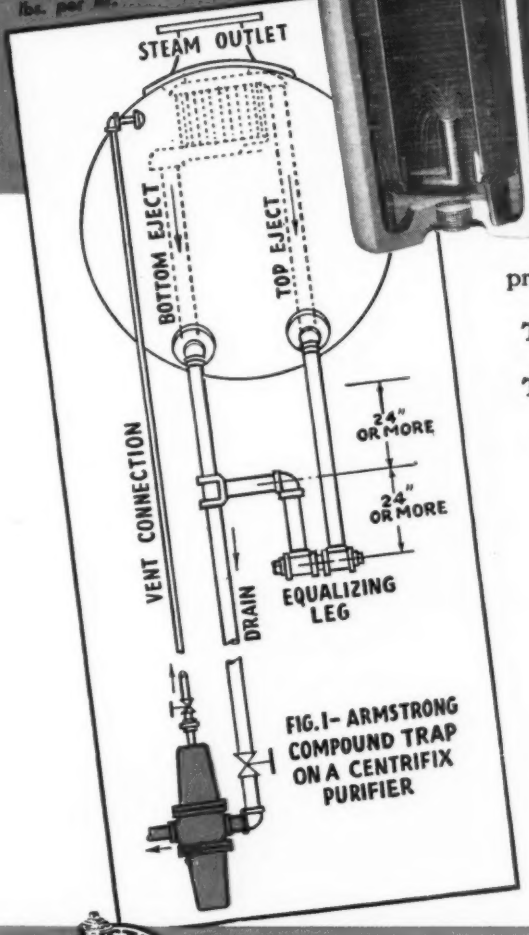


FIG. 1– ARMSTRONG COMPOUND TRAP ON A CENTRIFIX PURIFIER

Where load and water conditions cause foaming and priming at the boiler, Armstrong traps are a logical choice for draining the necessary purifiers and separators. Here's why:

They prevent slugs of water from passing beyond the purifier and damaging expensive steam-using units.

They quickly drain purifiers and separators which have small water-storage capacities.

Armstrong trapping of purifiers and separators outdates old-fashioned gravity drainage. Depending on capacities required, Armstrong offers either standard traps or piston-operated compound traps with semi-steel or forged steel bodies for this service.

Send for a copy of Catalog H for valuable information on separator and purifier drainage, with charts, data and tips on trapping problems encountered by engineers everywhere.

When Trapping Purifiers or Separators, remember to:

- **Install trap below purifier.**
- **Keep drain line to trap free from bends.**
- **Use a vent line as shown for quick opening.**

Armstrong Machine Works, 812 Maple St., Three Rivers, Mich.

ARMSTRONG *Inverted Bucket* STEAM TRAPS

Over a Million in Use... For Power... Process... Heating

EXTRA STRENGTH FOR HEAVY DUTY

KEWANEE

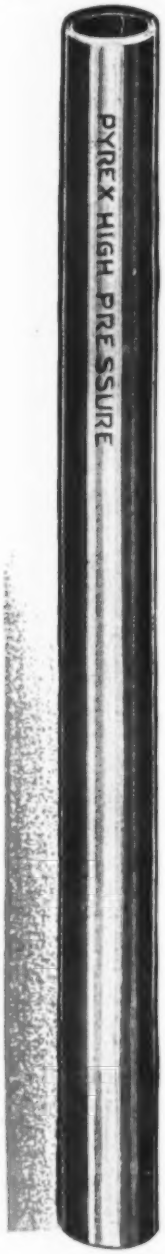
Steel Plus Rivets

Steel plus Rivets further strengthened by extra stout stays and braces. Embodies all characteristics which make firebox type boilers especially adapted for high pressure.... 4 to 304 H. P. 100, 125, 150 lbs. W. P.

75 Years Boilermakers

KEWANEE BOILER CORPORATION
KEWANEE, ILLINOIS

Write Department 96-K2 for 6" scale with pipe diameter marking.



Gauge Glasses TESTED for Temperature Shock

Heated to a temperature of 425°F and then plunged into ice water creates several times the thermal shock that any gauge glass is called upon to withstand. Yet that is a routine test for Pyrex Gauge Glasses. That is only one of the reasons why they stand up under actual service conditions.

Machine drawn accuracy that permits easy installation and reduces to a minimum installation strains that cause breakage, remarkable resistance to the solvent action of hot water or steam, a hard smooth surface that resists abrasion and scratching—are other factors which make Pyrex Gauge Glasses the most economical glass you ever used. Corning Glass Works, Corning, N. Y.

"PYREX" and "CORNING" are registered trade-marks and indicate manufacture of Corning Glass Works, Corning, N. Y.

CORNING Glass Works Corning, New York

Pyrex Gauge Glasses BRAND

supervision of J W Batten, district sales manager of Kansas City, Mo., and Tulsa, Okla., branches. Mr. Batten will now devote all his time to his regular activities.

Lt Comdr John B Freese, USNR, has been appointed director of purchases for **Ashton Valve Co,** Cambridge, Mass.

Wagner Electric Corp announces retirement of V W Bergenthal as an executive officer. He will continue to serve as a director. Mr Bergenthal is succeeded as treasurer by J D Eby who had been elected secretary-treasurer effective Jan 1, 1946. Mr. Eby had already been secretary.

Following changes in service branch personnel have been made by **Wagner Electric Corp:** (1) Forrest G Wilson has been appointed manager of Indianapolis branch. (2) H F Zahn became manager of Philadelphia branch. (3) C G Jackson has been moved to Atlanta to manage that branch. (4) J K Miller has taken over management of Boston branch.

J D Eby was elected secretary of **Wagner Electric Corp,** filling the vacancy created by the death of J W Westcott. Mr Eby assumes these new duties in addition to his present responsibilities as manager of purchases. K G Baker is back in the Indianapolis office as a field engineer.

Walter Kidde & Co elects Paul W Eberhardt to office of vice-president. His principal duties include management of domestic sales of company's fire-fighting equipment in aviation and general industry, together with general supervision of field selling activities. General sales office has been moved from 140 Cedar St, New York 6, N. Y., to office at 675 Main St, Belleville 9, N. J.

L C Boos has been elected president of **United States Rubber Export Co, Ltd,** and Herbert G Kieswetter has been elected vice-president.

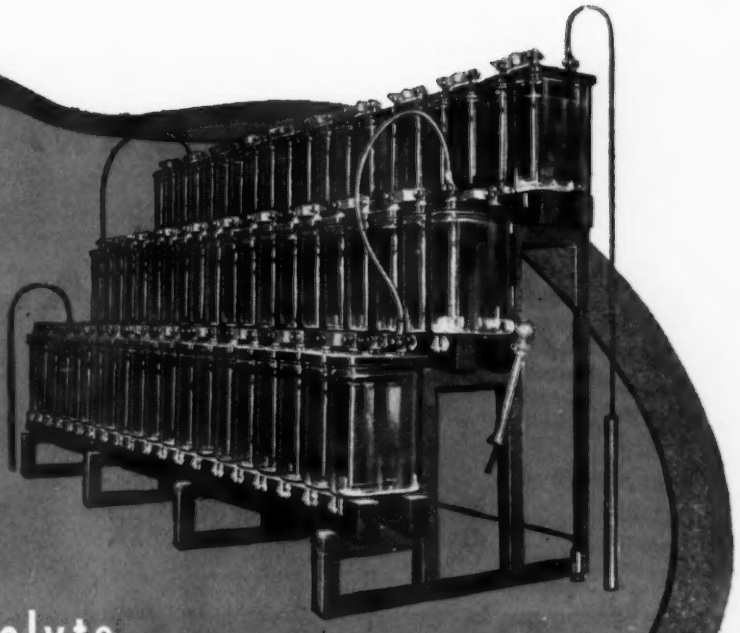
United States Rubber Co appoints five new vice-presidents: (1) Ernest G Brown, general manager of mechanical goods, general products, and lastex yarn and rubber thread divisions (2) John P Coe, general manager of Naugatuck chemical and synthetic rubber divisions (3) H Gordon Smith, general manager of textile div (4) John W McGovern, general manager of tire div (5) Elmer H White, general manager of footwear and fuel cell divisions. Each new vice-president retains his title of general manager and continues his division managerial duties.

American Engineering Co announces appointment of two additional sales representatives: (1) Southern Equipment Co, 204 S 4th St, Louisville, Ky, in the greater Louisville area and central Ky. (2) B & B Combustion Equipment Co, 4030 Chouteau Ave, St. Louis 10, Mo., in eastern Mo. and southern Ill.

Warren Steam Pump Co announces appointment of Gil Moore, 4031 Goodwin Ave, Los Angeles 26, Calif., as representative for their industrial line of reciprocating and centrifugal pumps. Mr Moore's territory em-

PROBLEM:

To find insulated cable for battery-charging leads—immune to attack by electrolyte



SOLVED WITH FLAMENOL CABLE

An Ohio steel mill required insulated cable for its battery-charging equipment, which consisted of a 250-kw generator and a 27-panel switchboard. Cable was needed for leads from panels to batteries. As the leads ran underground, the cable insulation had to withstand moisture as well as electrolyte fumes and accidental contact with the electrolyte itself. Four years ago, at G.E.'s suggestion, Flamenol* Style FL insulated cable was selected for the job. The mill reports that the original installation is still giving trouble-free service.

RESISTS CHEMICALS— Flamenol Style FL cable is highly resistant to oils, water, mild acids, and alkalies—and weather. It is tough and stable, is flexible at low temperatures, and has high dielectric strength. Flamenol does not support combustion—therefore, prevents outages due to fires. Requiring no protective braid, it reduces the volume of wiring and eliminates terminating problems due to fraying. Its insulation strips easily and leaves the conductor surface untarnished.

A G-E "FIRST"— Only G.E. makes Flamenol cable. Flamenol is the original cable insulated with plasticized polyvinyl chloride. G.E. introduced it in 1935—not as a substitute for rubber-insulated cable but as a new type possessing desirable properties not obtainable in rubber. To find out how Flamenol can help solve *your* problem—save you time, trouble, and expense—ask our local office, or write Apparatus Dept., General Electric Company, Schenectady 5, N. Y.

*Trade-mark reg. U.S. Pat. Off.

GENERAL ELECTRIC

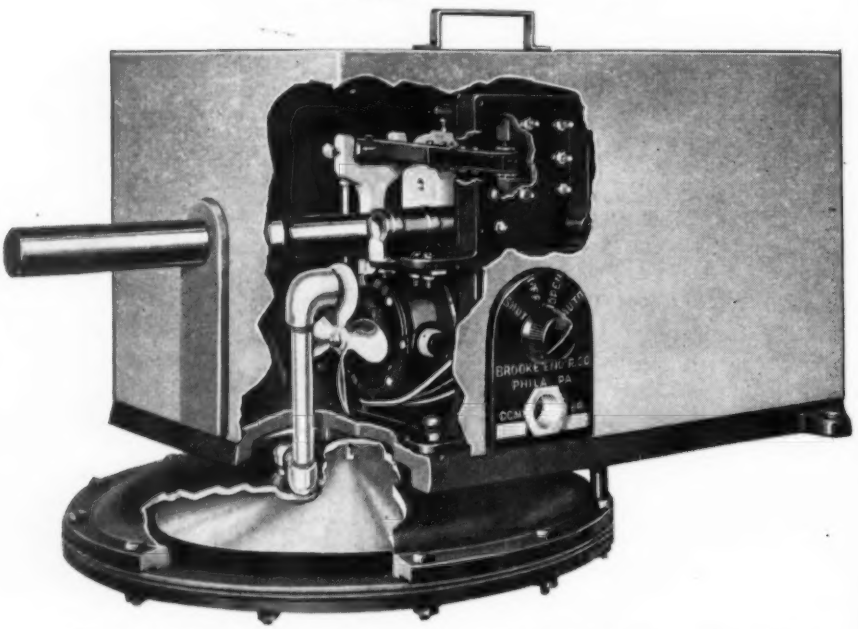
502-54-1200

✓ SAVE YOUR FUEL

✓ SAVE YOUR FURNACE

with the

BROOKE AUTOMATIC FURNACE DRAFT REGULATOR



An automatic draft regulator that will keep your furnace draft *just right*—despite changes in boiler loads or atmospheric conditions —will save you fuel and save your furnace! That's the Brooke Automatic Furnace Draft Regulator!

The Brooke Furnace Draft Regulator does the trick because it successfully combines four characteristics essential to dependency accurate draft control:

1. The Brooke Draft Regulator is extremely sensitive. Its large diaphragm responds to draft changes as small as .01" water column.
2. It is effectively fan compensated to prevent "hunting".
3. Minimum moving parts minimize friction. Electrically Actuated. No pilot valves, stuffing boxes or strainers.
4. Ample torque provides reliable operation of dampers which otherwise might stick, due to dirt accumulation.

These features *assure* you of saving on fuel and your furnace. Brooke Engineers are specialists in modern automatic high-accuracy boiler and furnace controls, are available to advise you, and will reply promptly to your inquiry. Detailed bulletin sent on request. Write us today.

BROOKE ENGINEERING CO., INC.

4517 Wayne Avenue · Philadelphia, Pa.

MANUFACTURERS OF THE FIRST SUCCESSFUL ELECTRIC EYE SYSTEM OF COMBUSTION CONTROL

braces southern Calif. south of and including counties of San Luis Obispo, Kern and San Bernardino, the state of Ariz., and Clark County in Nev.

Russell T Gray, Inc, announces that John R Armstrong has rejoined the agency after serving as a captain in training-literature and visual-aids section of Coast Artillery Corps. Mr. Armstrong, a vice-president in the advertising agency, will resume specialization in the industrial field.

Robert C. Hood, was elected secretary of **Ansul Chemical Co.**

Philadelphia Electric Co elects Charles S Redding director.

Henry B Bryans, executive vice-president of Philadelphia Electric Co, was elected president of **Electrical Association of Philadelphia.** Other officers elected were: (1) *Vice-president*—E W Loomis, district manager, Westinghouse Electric Corp (2) *Treasurer*—Philip H Ward Jr, president, Ward Electric Co (3) *Secretary*—Robert J Moran, chief of electrical district, Middle Dept Rating Association.

LeRoy L Benedict, for 25 years superintendent of western div of **Consumers Power Co's** electric production, transmission and construction dept, with headquarters in Grand Rapids, has been transferred to Jackson, Mich., as assistant general supervisor of the dept. In his new position Mr Benedict will assist Vice-president Frank G Boyce in supervising operation and construction of electric plants and transmission facilities throughout area served by Consumers. Leon M Day, in charge of safety and operating instruction in western div, now is assistant div superintendent and will serve temporarily as superintendent.

Payson D Foster, assistant treasurer of **Detroit Edison Co,** is terminating his active work with co after 36 years' service.

Reinard Michaels, who was recently discharged from the Army, was elected superintendent of **Laurel, Neb.,** municipal power plant at a meeting of the city council.

Public Service Electric & Gas Co made following changes in publicity and advertising dept in connection with retirement of Walter Fox Allen as director of publicity: (1) Robert A Zachary, vice-president in charge of public relations, will head publicity and advertising dept. (2) Joseph A Gallagher is named director of publicity. (3) Thomas H Spain is named director of advertising. (4) S Earle Clauss will be assistant director of publicity.

Diesel Engine Manufacturers Association elected following officers at its anual meeting: E J Schwanhausser, vice-president of Worthington Pump & Machinery Corp, was elected president. Gordon Lefebvre, president of Cooper-Bessemer Corp, and J E Peterson, vice-president, General Machinery Corp, were elected vice-presidents. Reelected as treasurer was Robert H Morse Jr, vice-president and general manager of Fairbanks, Morse & Co.

(*Continued on page* 206)

SITUATION WANTED

STOKER WITH 17 YEARS' EXPERIENCE

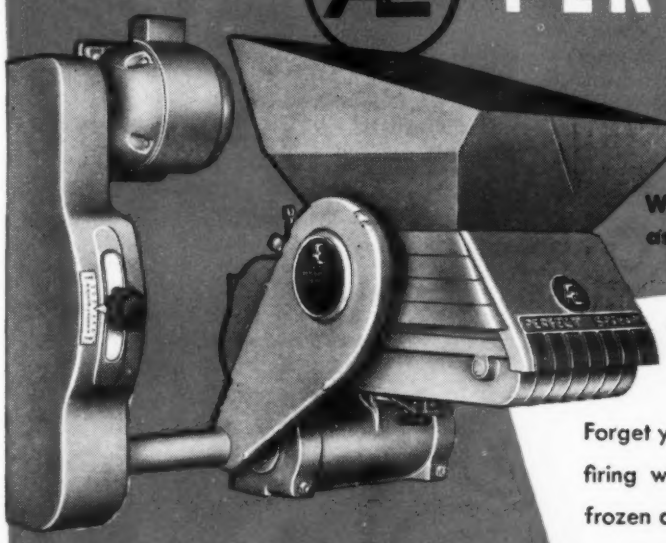
desires opportunity to prove exclusive **NEW** FEATURES

IT IS TRUE that the Perfect Spread Stoker has a 17-year record of *proved* performance and economy in 15 types of industries. It is also true that recent redesigning has greatly improved and simplified its operation. Here, now, is a vigorous employee that will work 'round-the-clock for you—producing more steam *automatically* at lower cost than you believed possible.

Feed this stoker the lowest available grades of coal and other solid fuels—wet, dry or partially frozen. Defy it to clog or fail or to let you down when steam is needed most. Then watch it continue spreading a "perfect" fuel bed at infinitely variable rates of speed by the dependable *overthrow* method. Hear how quiet it is, see how easy to operate, and how accessible are all parts—because they're protected by functional streamlining. Most important, watch this new addition to your boiler room staff quickly pay for itself out of fuel and maintenance savings. Please write and ask for the Æ Perfect Spread Stoker booklet.

Æ PERFECT SPREAD STOKER

With stationary grates, dumping grates or continuous ash discharge—up to 400,000 lbs. of steam per hr.



WON'T CLOG ON *Wet* COAL!

Forget your wet coal problems! Get steady, reliable fuel firing with the stoker that thrives on wet or partially frozen coal—that has the exclusive Æ non-clog feature!

OTHER Æ PRODUCTS: Æ-TAYLOR STOKERS, LO-HED HOISTS, MARINE DECK AUXILIARIES, HELE-SHAW FLUID POWER.

AMERICAN ENGINEERING COMPANY

2400 ARAMINGO AVE., PHILADELPHIA 25, PENNSYLVANIA

C. H. WHEELER
OF PHILADELPHIA

STEAM CONDENSERS

•

AIR EJECTORS

•

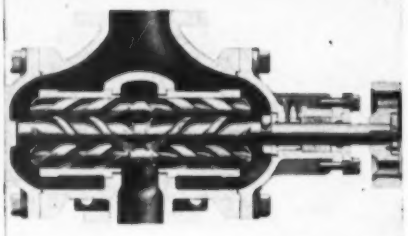
MECHANICAL DRAFT
COOLING TOWERS

•

DECK MACHINERY

C. H. WHEELER
MANUFACTURING Co.
19th St. & Lehigh Ave.
Philadelphia 32, Pa.

TO KEEP NOISE OUT
-PUT IMO IN



Where quiet, vibration-free pumping is essential, use an IMO...
made for
handling oils and other liquids
at all capacities and pressures
I-127

For further information, write for catalog I-127-P

IMO
PUMP DIVISION OF THE
DE LAVAL STEAM TURBINE CO.
TRENTON 2, NEW JERSEY

Harvey T Hill was reelected executive director. New directors who were elected are A W McKinney, vice-president of National Supply Co, and G F Twist, vice-president and general manager of Atlas Imperial Diesel Engine Co. Continuing on board of directors are George W Codrington, vice-president of General Motors Corp; Charles E Brinley, chairman of board, Baldwin Locomotive Works; Robert E Friend, president of Nordberg Mfg Co; Norris H Schwenk, president of Busch-Sulzer Bros-Diesel Engine Co; Mr Schwanhausser, Mr Morse and Mr Lefebvre.

United Engineers & Constructors Inc elected Charles W E Clarke vice-president and consulting engineer, Stanley C Cook vice-president and construction manager, Benjamin S Thayer, vice-president and construction manager.

F A Wright has been named as chairman of Industrial Control Section of **National Electrical Manufacturers Association.** Mr Wright is assistant general sales manager of Cutler-Hammer, Inc.

Prof Marcel K Newman has been appointed associate professor of mechanical engineering in College of Applied Science, **Syracuse University,** Syracuse, N. Y.

OBITUARIES

George Bridges, 58, pump application engineer and an employe for 40 years of Worthington Pump & Machinery Corp, died Dec 19 at his residence in Nutley, N. J.

Alan Estes Flowers, 69, head of research and development dept of De Laval Separator Co, died on Dec 3 in Vassar Hospital, Poughkeepsie, N. Y.

Charles C Hall, 70, founder and vice-president of Durametallic Corp, Kalamazoo, Mich., died at his home Dec 26.

George W MacDow, 59, president and treasurer of Norwood Engineering Co, died at Brookline, Mass., on Dec 9.

William Price Macdonald, 53, manager at Nanaimo, B. C., for British Columbia Power Commission, died at his home there Nov 30.

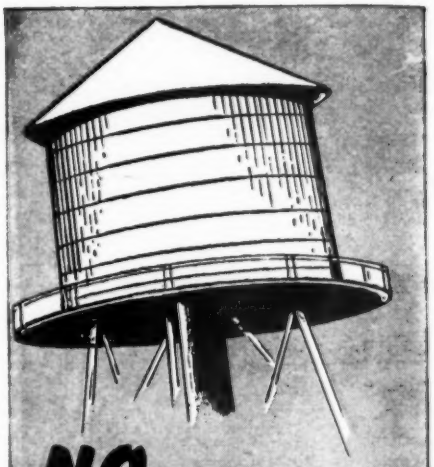
Frank C Angle, 45, manager of general machinery div field sales offices, Allis-Chalmers Mfg Co, Milwaukee, died recently after an illness of several months.

C Harold Wheeler Jr, 63, vice-president and general manager of C H Wheeler Manufacturing Co, died at the Presbyterian Hospital, Philadelphia, on Nov. 24.

J E Aldred, 82, one of the pioneers in field of hydroelectric development, died on Nov 21 at the Garden City Hotel, Garden City, L. I., N. Y., where he lived.

David S Boyden, 72, former superintendent of steam-heating dept of Boston Edison Co, died at St. Petersburg, Fla., on Nov. 26. He retired from Boston Edison Co in 1939 after 31 years on its staff.

James A Moyer, 70, for many years prominent in engineering educational activities, for 29 years director of the university extension div in Mass., died at Newton, Mass., on Dec. 1. Since his retirement he had been engaged in preparing a volume on high-speed diesel engines.



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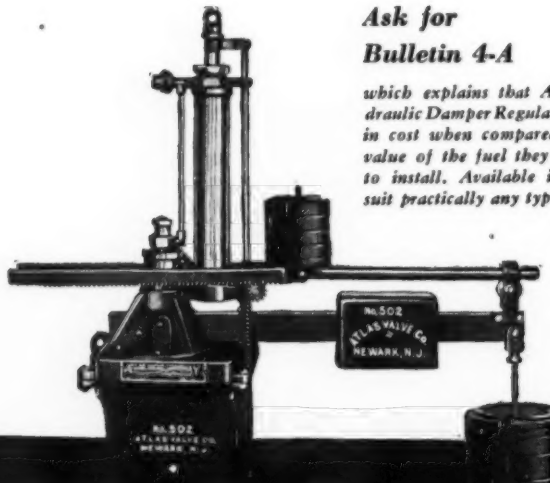

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Bulletin 4-A

which explains that ATLAS Hydraulic Damper Regulators are low in cost when compared with the value of the fuel they save. Easy to install. Available in types to suit practically any type of boiler.

ATLAS Damper Regulators

assure best maintenance of correct steam pressures.

For LOW PRESSURE..... WE RECOMMEND .....No. 501
For MEDIUM PRESSURE... WE RECOMMEND .....No. 502
For HIGH PRESSURE..... WE RECOMMEND .....No. 503

No. 501 is suitable for automatically regulating drafts of vapor or low pressure steam heating boilers. Can be adjusted to operate at any steam pressure up to 25 pounds.

No. 502 is the regulator pictured above. For boiler pressures up to 150 pounds. Will move damper on boiler pressure changes of ¼ pound.

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Water pressure is made to act automatically on a piston which is connected to draft doors or dampers by chain. Ample power is thus available for moving the heaviest doors or dampers. At the same time the control piston responds to slightest variations in steam pressure so that uniform pressure is maintained through closest adjustment of dampers and a resulting steady rate of combustion.

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On forced draft boilers ATLAS Regulators may be arranged to control fan speed. From the fan they may be made to indirectly regulate the feed rate of the stokers.

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☐ Pump Governors
☐ Float Valves
☐ Oil Control Cocks
☐ Humidity Controllers
☐ Thermostats
☐ Balanced Valves
☐ Control Valves

Condenser, Air Ejector

(*Continued from page 78*)

be bypassed on starting until proper operating steam pressure at the boiler is reached.

A good installation has a pressure gage near the ejector nozzles on the orifice low-pressure side. Excessive superheat reduces flow through the ejector nozzles as the steam specific volume increases more rapidly than its available energy. Pieces of scale or other obstructions in nozzles reduce flow area and give the same indications as low steam pressure; see note in Table II. In this case the pressure gage indicates adequate steam pressure to the unit.

Excessive air through the low-pressure turbine glands limits vacuum to the ejector stage capacity. Insufficient or entire lack of circulating water to the main condenser throws a terrific vapor load on the ejector. Insufficient condensate circulating water to the ejector condensers prevents the first stages from helping to prime the system and imposes an extra load on the second stages.

Fluctuations in vacuum, whether momentary or the rapid-bobble type, are almost always due to insufficient motive steam. Other causes are occasional flooding of the ejector condensers' vapor side because of faulty drainage, a momentary surge of air entering the system or a periodic build-up of backpressure on the aftercondenser vent. Sometimes variations in main-condenser circulating water flow have caused fairly rapid fluctuations in system vacuum. A surging hotwell pump can also induce cyclic fluctuations in vacuum but this cause is usually so evident as to be immediately discovered. A small leak in the vacuum gage system can also cause a momentary drop in vacuum reading, or if the leak is appreciable give generally low readings.

Low vacuum occurring suddenly may be either external to or caused by the ejector. Faulty operation within the ejector is almost always due to insufficient motive steam caused by insufficient pressure, excessive superheat or clogged nozzles. Other causes are leaking isolating valves, insufficient or too warm condensate circulating water to the ejector condensers, improper drainage, tube leaks, and eroded shell or isolating baffles.

If the abnormal condition is external to the ejector a performance-curve analysis indicates either the magnitude or nature of the trouble, or both. Previous discussion shows the second stages meter the amount of noncondensables to the system while the first stages meter the total load

IMPROPERLY TREATED BOILER WATER

An accurate analysis and survey of your plant by the Dearborn Engineer is the first step in solving any water treating problem.

Initial corrective measures are suggested and after consultation and additional analyses by the main Dearborn Laboratory, final and complete recommendations are made.

In using the Dearborn method of treatment and control, periodic check-ups and supervisory service keep steam production up to the required capacity.

Contact the Dearborn Engineer in your vicinity, when you have boiler water problems. Dearborn engineering skill makes any water fit required operating conditions.

RESPONDS TO *Dearborn* ENGINEERING SKILL

Dearborn Engineer does this for you . . .

1. *Studies* your water and plant operating conditions.
2. *Sends* samples of your water to main laboratory for analysis.
3. *Recommends* the proper chemical treatment and correct chemical control methods.
4. *Supervises* installation of feeding equipment.
5. *Instructs* your men on water test methods for treatment dosage adjustment and blow-down control.
6. *Calls* regularly at your plant to insure maintenance of the recommended conditions.

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IN YOUR STEAM SYSTEM GIVES YOU THESE IMPORTANT BENEFITS!

- PREVENTS CORROSION
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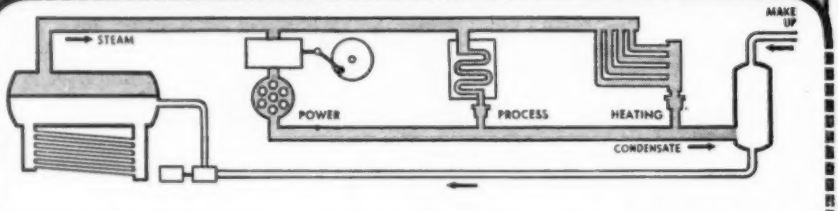

The CORAVOL ZONE—indicated by the shaded area in the diagram—includes every part of a steam system not accessible to boiler feed water treatment. It includes the boiler above the water line, steam lines, condensate return lines, radiators, valves, traps and equipment. This zone can now be reached and protected against rust and corrosive action—by CORAVOL.

CORAVOL IS PART OF A COMPLETE TECHNICAL SERVICE WHICH PROVIDES SPECIAL FORMULAS OF TREATMENT FOR:

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CORAVOL protects lines; increases effectiveness of heat transfer surfaces; restores original capacity of lines and the operating efficiency of valves and traps.

Not a boiler feed water treatment, **CORAVOL** is designed expressly for use in steam systems. Because **CORAVOL** volatilizes and condenses with the steam, it circulates thruout your entire steam system and protects *all* zones from corrosive attack.

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to the ejector. If load examination proves it is not excessive for the unit under the abnormal conditions, the trouble must lie farther back in the vacuum system. With normal air component and high total load, it probably comes from dirty main-condenser tubes or abnormal circulating-water flow. With a high air component the load must be from increased air leakage or increased noncondensable release from the feedwater chemicals.

Table II shows possible sources of air leakage for increased air load. Second column, "Relative audibility at source," indicates roughly the amount of hissing to expect if leakage is concentrated at one spot. Excess air values have been taken to very high limits as priming ejectors or "hoggers" have capacities of several thousands of lb per hr in the initial stages of evacuating the system. While the causes listed are incomplete, they do indicate likely spots.

No other common type of vacuum apparatus has this close relationship of absolute pressure and capacity. Because of stage design, multiplicity of compression stages simplifies rather than complicates load analysis. Fundamentally an ejector works correctly or not at all. If second-stage blank suction values (closed suction valve) and first- and second-stage combination blank suction values give the expected results, the ejector is almost certain to be operating properly and the load readings can be trusted.

The Heat Balance

(*Continued from page* 93)

percentage of air over the theoretical or excess air. Since all fuels have a different chemical composition the CO_2 for the same excess air will be different for each type of fuel. We try to operate a furnace at not higher than 30% excess air; with bituminous coal that is about 14% CO_2; with oil about 11.5% CO_2; with natural gas about 9% CO_2. Expert operation and design produces better results. Percent CO_2 is therefore an indication of combustion efficiency only when all parties know the type of fuel being burned, whereas percentage of excess air is a direct indication of efficiency if the flue-gas analysis shows no CO.

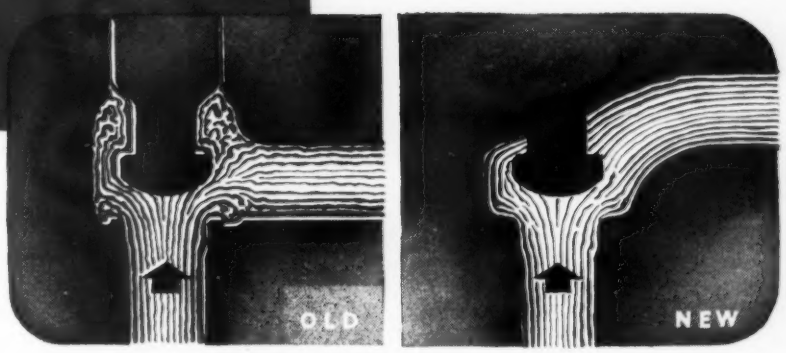
Approximate percentages of excess air of the three tests are as follows: Jacobus, 35% (13.7% CO_2); Wolff, 27% (14.5% CO_2); Grunert, 25% (14.7% CO_2). The stoker used with the Jacobus tests was one of early design in which air distribution had not been as carefully worked out as in the modern type. Because the mixing was less complete than in the

valve now *Streamlined* to reduce pressure loss

● Typical of SK leadership in valve engineering is the newly developed streamline valve body which reduces pressure loss to a minimum. A separate alloy cylinder having a hard-surfaced bushing is provided in the valve body to guide the disc assembly at two points assuring proper alignment, even seating and positive trouble-free operation. The double-welded seat ring includes a special isolated seal weld which eliminates possibility of distortion of the seat face.

Consult Schutte & Koerting about special high pressure valves or write for information on Boiler Non-Return Valves and Check Valves (Bulletin No. 8-B), Pressure Reducing Valves (Bulletin No. 8-R), and Turbine Valves (Bulletin No. 8).

Both angle and globe valves embody these advantages and are available in any size for pressures up to 2500 psi with toggle top, or outside screw yoke, for either hand or motor operation



Comparison of flow through conventional valve body and the new SK Streamlined valve

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FROZEN PARTS ?

RUSTY NUT ?

LET TASGON DO IT!

Save your time and energy by using Tasgon, the most efficient rust solvent and penetrant on the market. Tasgon keeps machines humming—cleans tools and machines—loosens parts that are corroded or stuck. Tasgon cuts through gummed-up oil, dirt, and grit in just a few seconds. Use Tasgon and your savings in upkeep will pay for it many times over.

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FIRE BRICK CEMENT

Same Production less maintenance cost with ADAMANT

Lay-up linings with Adamant . . . Its higher bonding strength (see below) protects the structure at the joints where failure usually begins. Result . . . linings last longer . . . production is maintained . . . repair costs and replacement materials saved.

ADAMANT
Stronger by Test

Impartial laboratory tests showed Adamant has a bonding strength of 800 lbs. at room temperature; 1270 lbs. at 2609° F. Adamant has a P.C.E. of 3000° F. plus. For more details, write

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ENDURING SERVICE

639

For economy of operation and maintenance; for dependable performance in continuous heavy duty service over long periods, PENNSYLVANIA duplex, direct connected, synchronous motor driven compressors of the type illustrated have earned the endorsement of industry wherever installed.

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PPC
PENNSYLVANIA PUMP & COMPRESSOR CO
BUSHKILL PARK ROAD, EASTON, PENNA

other tests it was impossible to reduce the excess air without forming CO. The Wolff furnace burned pulverized coal thus simplifying the mixing of air and coal. Also the very long flame travel gave ample time to complete combustion.

The Grunert furnace was equipped with a turbulent type of burner which gave the flame an initial spiral motion allowing time for combustion with a shorter flame length and smaller furnace.

If the three boilers had been identical, the Jacobus tests would have shown a slightly higher exit-gas temperature. All tests show the best that could be accomplished with the equipment available in those years.

Comparative Temperatures

Temperature of the gas leaving the unit for the Jacobus test was 493 F, 100 F higher than the water in the boiler. For the Wolff test it was 259 F, 143 F *lower* than the temperature of the water in the boiler, and about 100 F higher than the water entering the economizer. The lower gas weight and lower exit-gas temperature of the Wolff tests reduced the dry-gas loss from 10.12% to 4.20% thus increasing unit efficiency 5.92 points. The lower exit-gas temperature also reduced the moisture loss somewhat because the moisture left at a lower temperature. This gain appears in the item of moisture loss.

Grunert's tests were made at a combustion rate of 33,000 Btu per hr per cu ft of furnace volume; Wolff's at less than 15,000 Btu. Grunert sacrificed 0.42 points in efficiency by leaving 2.50% carbon in the ash but was able to operate with the lowest excess air and without CO.

Lowest exit-gas temperature obtained by Jacobus was 493 F. When the output of the boiler was doubled the temperature rose to 651 F and the efficiency dropped to 75.84%, a loss of 4.44 points, due chiefly to the gas-temperature rise of 158 F—2.7 points loss per 100-F rise. Principal reasons for Wolff's higher efficiency were a lower dry-gas loss (by operating with lower excess air), lower carbon loss, higher combustion efficiency, and the use of an economizer to cool the gas to below the temperature of the water in the boiler. Grunert obtained substantially the same efficiency with a combination of economizer and air heater.

Gas temperatures and efficiencies of the Jacobus and Wolff tests are plotted in Fig. 1. Note that the temperature of the gas leaving the boiler of the Jacobus tests is higher than for similar rates of evaporation for the Wolff tests. Part of this difference is due to the higher percent of excess air during the Jacobus tests. Note also the increase in carbon loss with increase of output of the Jacobus tests. It will be noted that all

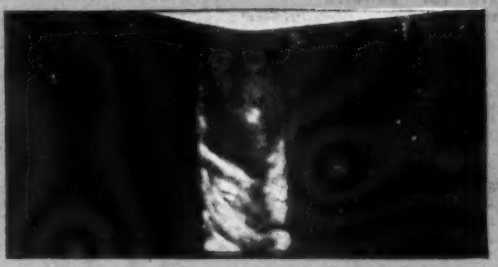
SAYS THE MAN IN THE HELMET—

"For flat, smooth fillets on vertical and overhead welds, you can't beat AIRCO No. 230 Electrode . . . .

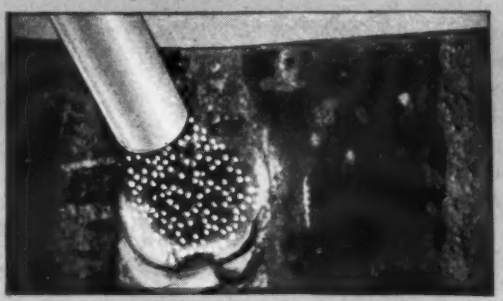
AWS Classification E 6011

". . . It's tops in the field for all-position AC welding.

"I like the neat, smooth fillets it gives on vertical and overhead welding. They're unusually strong, deep welds, too — good enough to meet the strictest code requirements.



"The metal sets up rapidly, which is one of the reasons why this Airco No. 230 is an especially fine electrode for making vertical and overhead welds.



"Slag doesn't interfere and the fine spraying action and lack of arc-blow help out greatly, too.

"I use it on AC or DC. It's mainly a grand all-position AC electrode, but it works fine with DC reverse polarity, too. It's easy to identify by this A.W.S. color marking—white end and blue band. Conforms to A.W.S. Classification E6011."

Airco electrodes are made in a complete range of types and sizes for every welding job. The new catalog describes Airco's complete line.

For a free copy write to the local Airco office or to Dept. P. Address Air Reduction, General Offices: 60 East 42nd St., New York 17, N. Y. In Texas: Magnolia Airco Gas Products Company, General Offices: Houston 1, Texas. Represented Internationally by Airco Export Corporation.

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AIR REDUCTION
Offices in All Principal Cities

AIRCO ELECTRODES FOR BETTER WELDS AND EASIER WELDING

Gives You

LONG, TROUBLE FREE SERVICE!

Fig. 1635

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PILLOW BLOCKS

The attractive "Standco" Pillow Block shown above is sturdily built and is offered in a wide range of sizes. Babbitted and broached bearing surfaces, accurately machined faces. Can be amply lubricated.

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STANDARD PRESSED STEEL CO.

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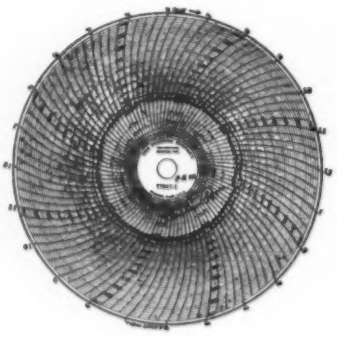
CAN YOU MATCH THIS CHART IN YOUR BOILER ROOM?



It is being done—by returning high pressure condensate to the boiler room with the

Sterling

Exclusive—No Vent—Heat Retaining—Condensate Return System

Use no electricity. No lost operation on account of current failure. Noiseless operation and low maintenance cost.

[Also lifting — Pumping — Vacuum Creating and Vacuum Draining Units]

Sterling Engineering & Mfg. Corp.

(Templeton Mfg. Co.)

110 Business St., Hyde Park, 36

MASSACHUSETTS

Wolff tests show negligible carbon loss.

Grunert started under a handicap. The coal available carried a large percentage of moisture that caused trouble in the pulverizers. He used hot air from the air heater to dry the coal before pulverization and entered this loss (1.47%) in the heat balance. Without this loss his efficiency would have been substantially the same as Wolff's. He reduced the expensive boiler surface by substituting less expensive economizer and air-heater surface and made the whole unit more compact, thus decreasing the size of the boiler house.

If Jacobus had doubled the boiler surface he might have reduced the gas temperature by 50 F and gained about one point in efficiency. But if he could have installed modern stokers with better air distribution he would have improved efficiency about four points. With economizers and modern stokers his efficiencies would have been the same as Wolff's.

If we are limited to the installation of a boiler without economizer or air heater and carefully select the furnace we can expect an efficiency of 80 to 82% at an evaporation of 3.5 lb per sq ft and 75 to 80% at 10-lb evaporation. The higher efficiencies will be obtained with fuels of low ash, hydrogen and moisture.

Furnace Design Important

These three tests show that the effect of boiler design is less marked when the evaporation per sq ft is the same. Tube size, arrangement, baffling and waterwalls all have some effect on heat absorption but the subject is too large to discuss except in a series of articles. The mistake that a purchaser may make in the selection of a boiler, if the evaporation rate is the same, is negligible compared to the efficiency loss that may result from a poorly designed furnace.

If we are willing to pay for an economizer or air heater, or both, with the boiler we may expect a gross unit efficiency of 88 to 90%. Generally the gain in efficiency above 85% is obtained at large increase in equipment cost difficult to justify except for large units operating at a high load factor.

When the steam-generating unit has been installed we may confidently expect to operate it at very close to the guaranteed efficiency when the load is reasonably uniform. It is worth while to study the Wolff paper because it includes tests of the boiler under actual operating conditions with short banking periods. The efficiencies obtained range from 89.0 to 91.2% with and without automatic combustion control. [EDITOR'S NOTE: *A short article by Mr. Shoudy in March* POWER *will summarize his conclusions regarding design and operation of steam-generating units.*]

REMOVES SOOT & FIRE-SCALE WHILE BOILERS OPERATE

CHIPPING AND SCRAPING IS UNNECESSARY when you use XZIT. Simply feed XZIT into the firebox while the boilers operate. When thrown on the fire in a furnace it forms a gas which permeates all parts of the boiler, the uptakes, and the stack and has a chemical reaction on the soot and fire scale.

XZIT can be used to extinguish stack fires and to stop sparking. Regular use keeps boilers and stacks clean and free of soot and fire-scale.

Used by all types of merchant and naval ships, XZIT is a proved product. Write for demonstration or order a trial supply. There is an XZIT representative near you.

XZIT FIRE SCALE & SOOT ERADICATOR

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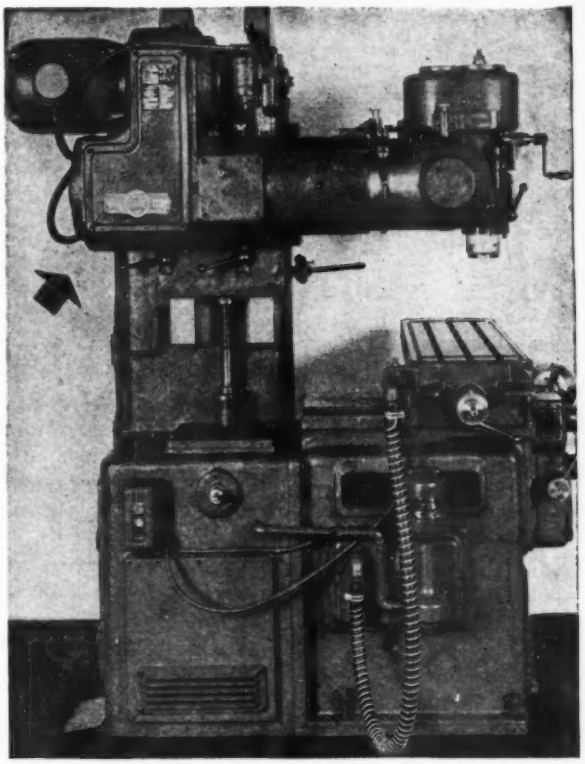
Give Your Production a Permanent Boost!

INSTALL REEVES-EQUIPPED MACHINES



Typical Example Spindle speeds on this new Reed-Prentice No. 12-V Tool Room Milling Machine are infinitely variable through a REEVES Motodrive incorporated within framework of adjustable ram. Operator secures any speed from 97 to 1730 r.p.m. merely by pressing a button. Does face or straddle milling as well as boring, drilling, die-sinking and duplicating.

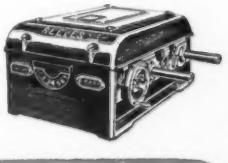
● Reconversion is creating a lot of production problems. Many manufacturers, perhaps yourself among them, are bringing out new products . . . dealing with new shapes and sizes . . . new materials and processes . . . all of which will be subject to later changes and refinements.

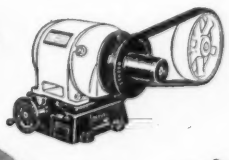
For this reason farsighted management is on the lookout for machines that are easily adaptable to variations in the production setup . . . machines that will *not* become "white elephants" when product specifications are altered . . . machines that will give production a *permanent* boost.

Any machine equipped with a REEVES Variable Speed Drive is a more versatile machine . . . more flexible and more adaptable to changing requirements. Speeds can be adjusted with precision over a wide range. Each operation can be performed at the most efficient speed to assure highest *quantity* and *quality*. The REEVES-equipped machine can turn out a greater variety of work. Without shutting down his machine, the operator can instantly select the speed that matches his skill . . . that is best for each size, shape or type of material . . . that is in step with any change in the complete production schedule.

For machines that will take eacn changing condition in stride . . . for machines that will give you immediate and continuous advantages, choose from the 1,872 different makes of machines that are REEVES-equipped for complete speed adjustability. Send for copy of 96-page Catalog P-450.

VARIABLE SPEED TRANSMISSION for infinite speed adjustibility over wide range of speed ratios, 2:1 through 16:1 and in sizes to 87 h.p.



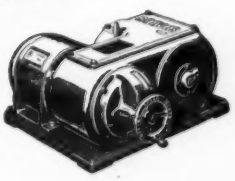


VARI-SPEED MOTOR PULLEY converts any standard constant speed motor to a variable speed drive. Sizes to 15 h.p. Speed variation within 4:1.

Accurate Variable

REEVES Speed Control

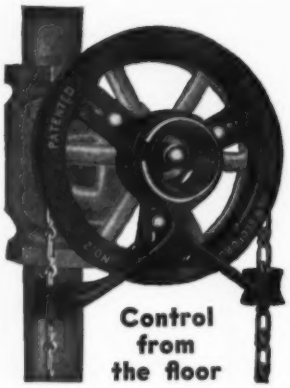
Gives the Right Speed for Every Job!



MOTODRIVE combines motor, speed varying mechanism, reduction gears in one compact unit. Sizes to 15 h.p. Speed variation 2:1 through to 6:1.

REEVES PULLEY COMPANY • COLUMBUS, INDIANA

Make Your Overhead Valves SAFE and Easy to Reach---



With the Babbitt Rim for Valves you eliminate danger and banish the step ladder. You can now place your valves wherever they come economically and conveniently. They fit any valve. Let us tell you more about them. Write today.

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New Bedford, Mass.

HERCULES SEAMLESS COPPER FLOATS

GUARANTEED TO STAND UP!

Every Hercules Float carries our guarantee to stand up under 350 lbs. working pressure and 500 degrees temperature.

Fabricated of seamless copper under our special spinning process. Hercules Floats are uniform in thickness and high in mechanical strength.

You can depend on Hercules for floats—in standard shapes up to 10 in. and iin special types to your specifications—to give long, dependable, economical service. Insure carefree maintenance of water level in your heaters, tanks, reservoirs and other equipment by specifying "HERCULES."

HERCULES FLOAT WORKS
200 Franklin St.
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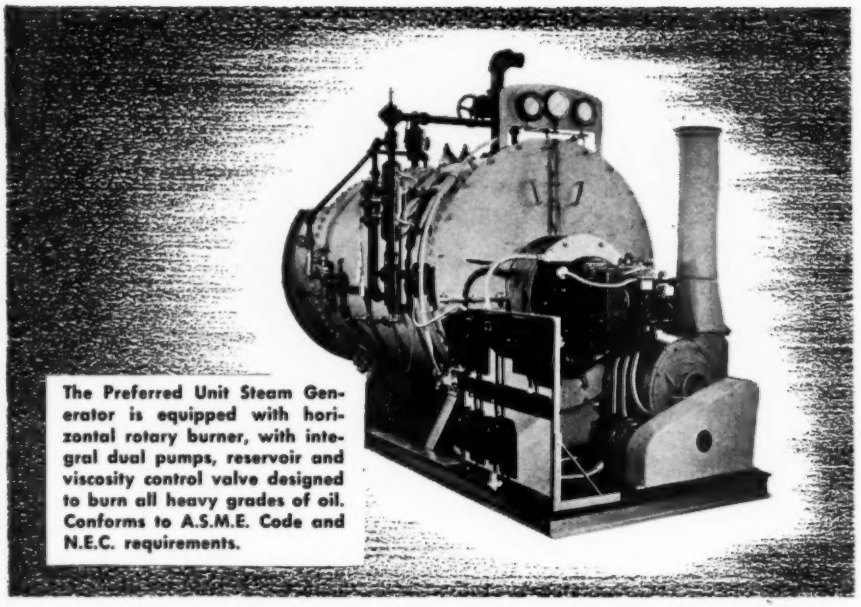

The Preferred Unit Steam Generator is equipped with horizontal rotary burner, with integral dual pumps, reservoir and viscosity control valve designed to burn all heavy grades of oil. Conforms to A.S.M.E. Code and N.E.C. requirements.

The PREFERRED Steam Unit Generator . . . . Generates Profits, too!

***Because*—Only the PREFERRED Unit Steam Generator Offers All These Features:**

1. **Pull-Through Draft—There is no stack to build . . . just a vent to outside air. Furthermore, the induced draft fan controls air-volume, provides the exact amount of air needed for perfect combustion without the danger of toxic products of combustion being forced into the boiler room.**
2. **Semi or Full Automatic Operation—Preferred Unit Steam Generators are equipped to burn light or heavy fuel oil and to operate either semi or fully automatically.**
3. **Low Maintenance With Respect to Refractories—due to the use of specially designed burners, and 25 years of combustion "know-how".**
4. **Full Range of Sizes—The PREFERRED Unit Steam Generator is available in sizes from 20 to 500 B.H.P. and pressures up to 200 lbs.**

The cost-problem of steam is thoroughly discussed in a new booklet containing ten authoritative articles on steam. There is no advertising. In the booklet you will find such articles as: "'Good' Boilers can waste money". "If Steam Were A Raw Material", "Stack or Fan for Draft".

You can have this booklet FREE, along with our Bulletin No. 1000, which describes in detail the "profit-generating" features of the PREFERRED Unit Steam Generator. The coupon below will bring your copies by return mail. Clip and mail TODAY!

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OBSOLETE POWER TRANSMISSION EQUIPMENT

Whether you generate your own power or buy it from an outside source, you cannot afford to waste it; therefore you cannot afford obsolete power transmission equipment.

Modern line shaft hangers and pillow blocks equipped with Timken Tapered Roller Bearings are saving power and time and slashing maintenance costs in thousands of factories by eliminating friction and wear; simplifying lubrication; providing full protection against radial, thrust and combined loads; and holding shafts constantly in alignment.

Throw out those obsolete power wasters now and replace with Timken Bearing Equipped power savers. Make sure the trade-mark "TIMKEN" appears on every bearing you use. The Timken Roller Bearing Company, Canton 6, Ohio.

A modern power-saving Dodge-Timken Pillow Block.

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There are plenty of big jobs today in Combustion Engineering. Such jobs have always been big pay jobs—and today they are better than ever. High fuel and equipment costs means a greater demand for combustion trained men than ever before.

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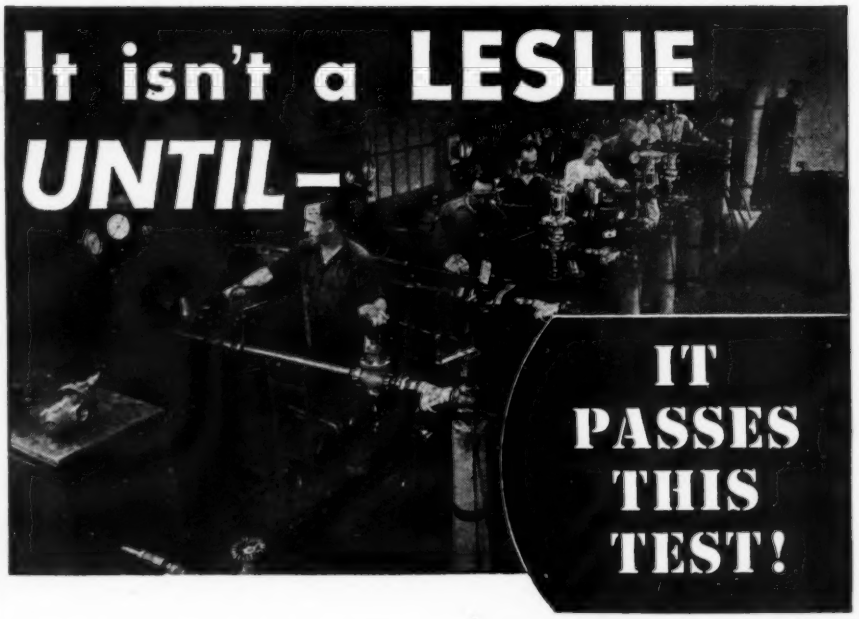
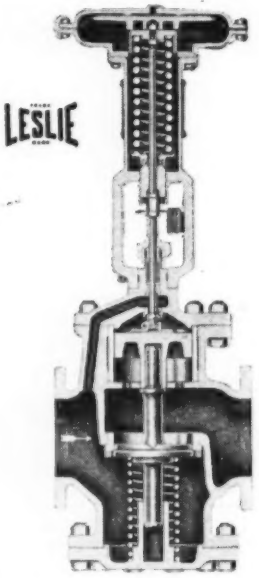


Built into every step in the manufacture of every LESLIE Regulator is an almost endless chain of rigid control, inspection and test operations, starting with control of the molten metal itself and following right on through to the individual finished part.

But, that is not enough! For *no* LESLIE Regulator has earned the right to go out on a job and render long, trouble-free operation until it has passed completely assembled through the Test Department shown above.



LESLIE Class D-1, Single-Seated, Balanced Diaphragm Regulating Valve with Type PR Control Pilot.

Here, each Regulator is placed in a test steam line at actual working pressures and put through its paces by a battery of skilled test engineers—another in a long series of reasons why the name LESLIE is often considered synonymous with low maintenance cost—why LESLIE Regulators stay on in service year after year without replacement. If this is the type of performance you are seeking in a Regulator, why not consider a LESLIE?

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Cleveland, Ohio	Montreal, Que., Can.	Seattle, Wash.
Dallas, Tex.	New Orleans, La.	St. Louis, Mo.
Detroit, Mich.	New York, N. Y.	Syracuse, N. Y.
Fremont, Neb.	Philadelphia, Pa.	Toronto, Ont., Can.
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PRESSURE REDUCING VALVES • PUMP GOVERNORS • PRESSURE CONTROLLERS
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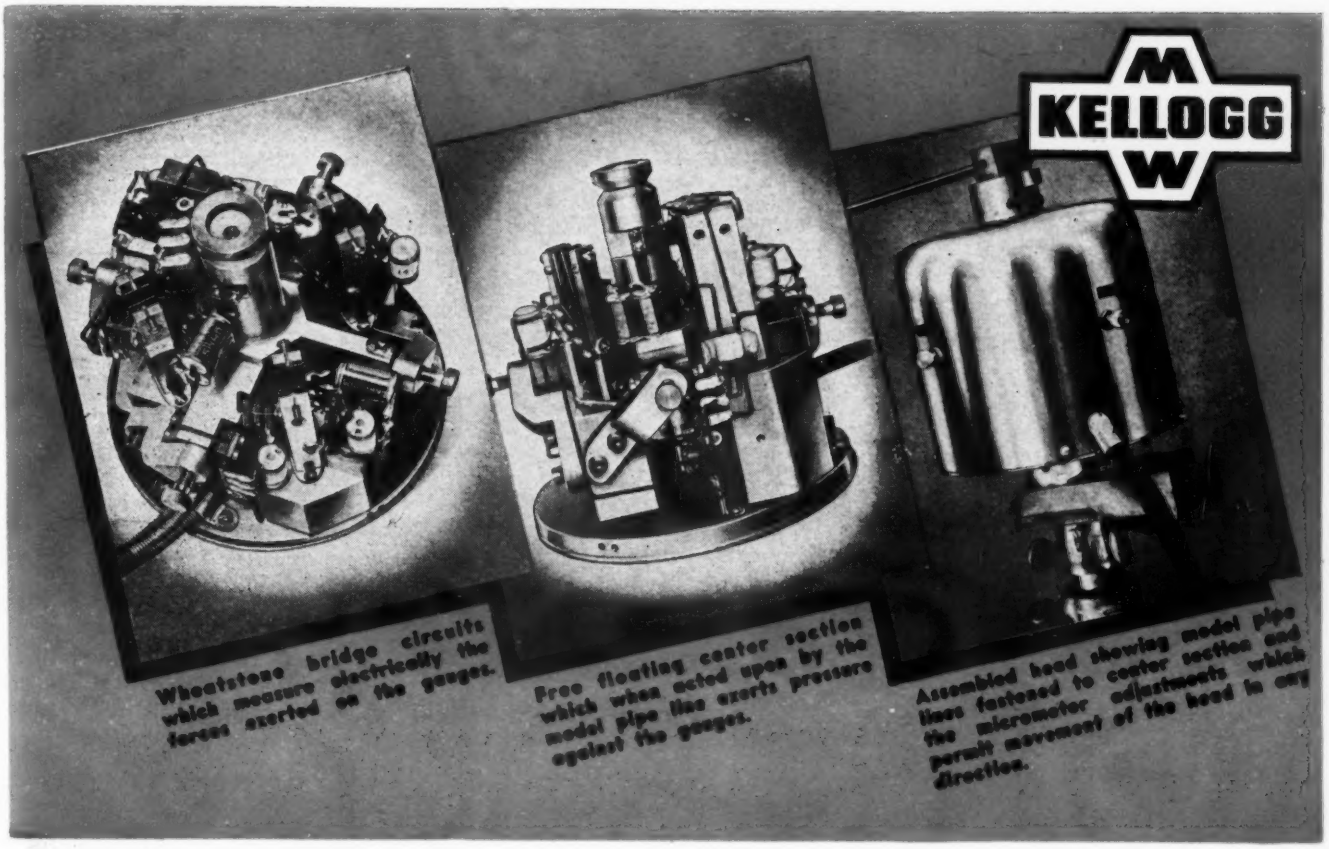
KELLOGG
Wheatstone bridge circuits which measure electrically the forces exerted on the gauges.
Free floating center section which when acted upon by the model pipe line exerts pressure against the gauges.
Assembled head showing model pipe lines fastened to center section and the micrometer adjustments which permit movement of the head in any direction.

These Heads Measure Load Deflections to ONE-MILLIONTH of an INCH

These super-sensitive instruments were designed and are used exclusively in the Kellogg Engineering Department for the benefit of Kellogg piping clients.

By using the Kellogg model testing apparatus, the most complicated design problems of high pressure, high temperature piping assemblies are solved accurately and quickly.

The "bugs" are found and eliminated before the final drawings go to the shop. This design research service is available to consulting, power, process and marine engineers.

A new bulletin "Analyzing Piping Stresses by Tests of Models" has just been issued. Write today for your copy.

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"Masterflex" Prefabricated Piping Systems. "Masterweld" pressure vessels for Power, Refinery and Chemical Industries. Heat Exchangers. Pyrolytic and Catalytic Cracking Units, Hydroforming, Reforming, Dehydrogenation, Alkylation, Desulphurization. Thermal and Catalytic Polymerization Units. JUIK Processes for Lubricating Oil Plants. Plastic Refractories. Radial Brick Chimneys.

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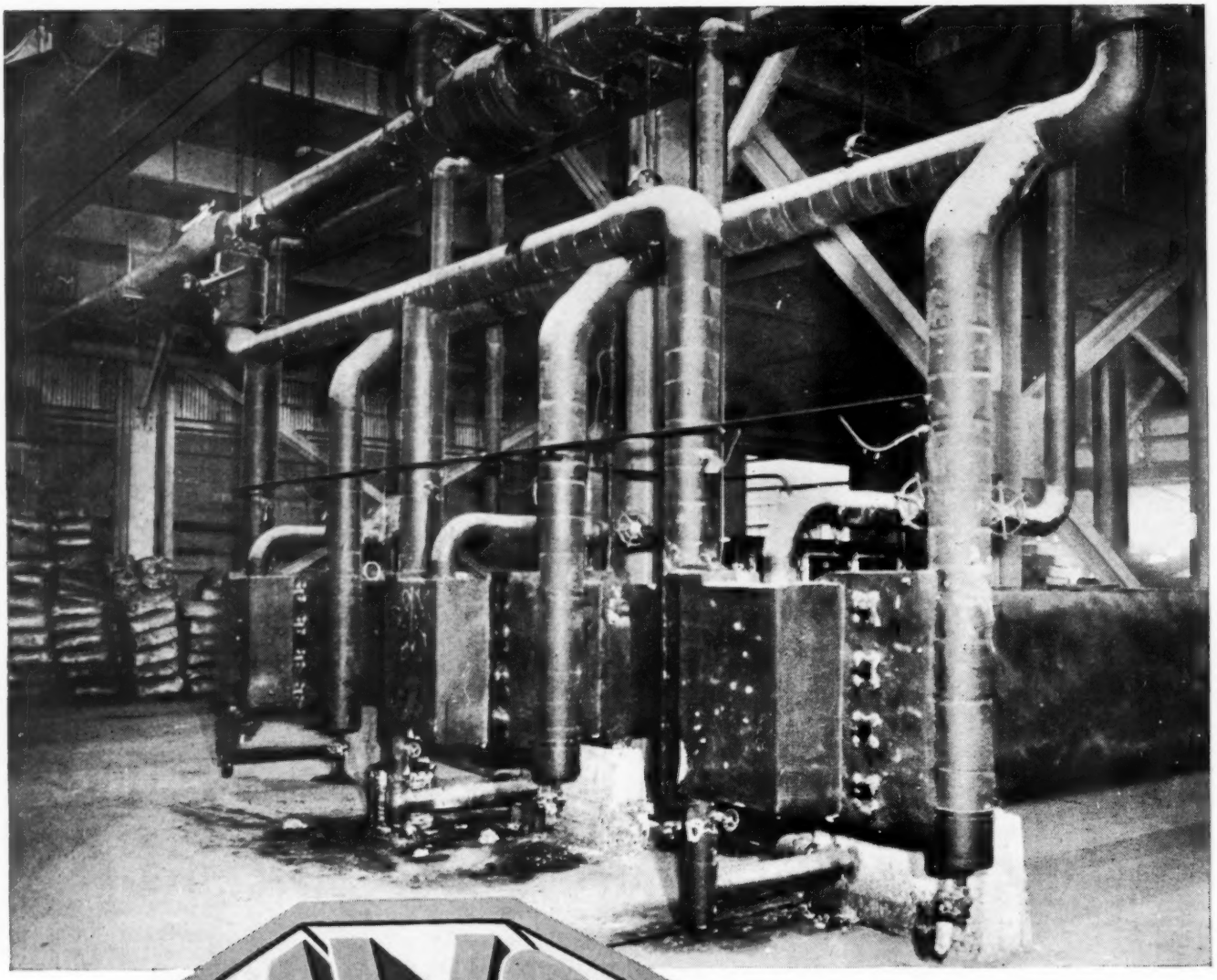
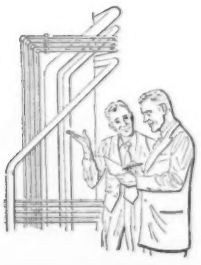


NAVCO

TROUBLE FREE SERVICE



The high degree of skill acquired by Navco Engineers from long experience in solving unusual Piping problems is your guarantee of trouble free service.

Consult Navco for your next Piping job.

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NEW YORK • CHICAGO • CLEVELAND • BOSTON • ATLANTA • TULSA • BUFFALO

TUBE CLEANING PROBLEM

solved by WILSON

ECT AIR MOTOR

UP TO 40% MORE POWER WHILE "TAKING THE CURVES"

Negotiating a curve is one of the toughest jobs for tube cleaners. Naturally, a small diameter motor can "take the curves" easier than a larger one — but in building motors for curved tubes, power has often been sacrificed for small diameter.

Wilson Engineers tackled this important problem and after years of research, developed the ECT Series Air Motor, combining small size with greater power. Size-for-size, the ECT Series Air Motor has often developed up to 40% more power than ordinary motors.

and here's how . . .

Its six-bladed, light-bladed construction, together with exclusive automatic valving of operating air, gives you these advantages:

- **Higher torque at any speed** *because six-blades produce a smoother flow of power . . . 12 powerful impulses per revolution.*
- **Less air consumption** *with a minimum of back pressure, is obtained from automatic valving of operating air.*
- **Positive starting—***Six-blades eliminate the dead center . . . hard to stall.*
- **Less downtime** *because up to 40% extra power helps you get your tube cleaning jobs done faster, more thoroughly with consequent savings in labor and lost production time.*

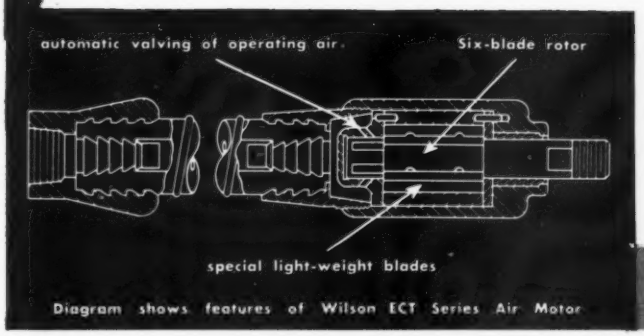


Diagram shows features of Wilson ECT Series Air Motor

Send for additional information on Wilson ECT Series Air Motors . . . or for the name of the Wilson representative nearest you. Address department M.

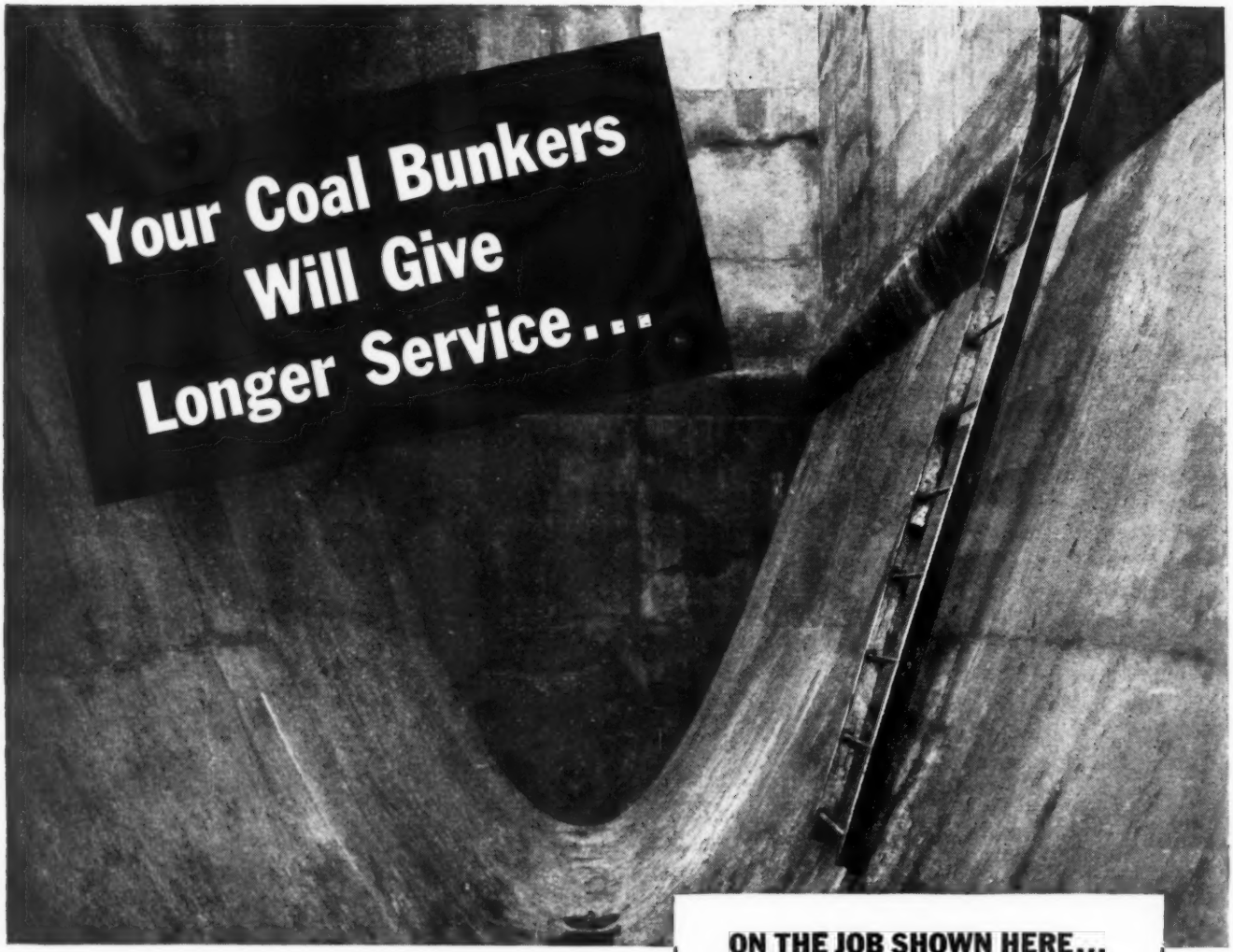
TW-702

THOMAS C. WILSON, INC.

21-11 44th Ave., Long Island City 1, N. Y.

WILSON

TUBE CLEANERS



...when armored with LUMNITE linings!

Protective linings of corrosion-resistant concrete—made with LUMNITE—will increase the life of your coal bunkers. For this super-tough concrete withstands abrasion and resists corrosive action of acid waters.

LUMNITE linings may be plastered over reinforcing mesh (like the one shown in the picture), shot on with a gun or cast in forms. Because LUMNITE is a rapid-hardening cement, the bunker is ready for use 24 hours after the concrete is placed.

ON THE JOB SHOWN HERE...

DIMENSIONS OF BUNKER:
32′ long x 16′ wide x 26′ deep.

WIRE MESH:
6 x 6 mesh (#10 wire) spot welded to ¾ inch nuts which were welded to the shell on 12-inch centers.

CONCRETE:
1 part Lumnite to 3½ parts sand and sufficient mixing water to provide a plastic mixture. Concrete is 2″ thick.

LUMNITE linings *also protect flues, stacks, cinder-catchers and ash-hoppers from corrosion, abrasion and high temperatures. Write for information on the type of LUMNITE lining to use on your job.*

THE ATLAS LUMNITE CEMENT COMPANY

(United States Steel Corporation Subsidiary)

Chrysler Building • New York 17, N. Y.

THEY CALL 'EM JEEPS

BECAUSE THEY'RE SMALL, BUT POWERFUL, AND GO ANYWHERE

For a small, tough, hard-working turbine that will go anywhere and do all you expect of it . . . get a Coppus "Blue Ribbon" Steam Turbine.

Coppus Steam Turbines come in six frame sizes from 150 HP down to fractional—so you can match more closely your job requirements. Each smaller size is priced correspondingly less, so by selecting "horsepower" instead of "elephant power" you save on investment and installation cost.

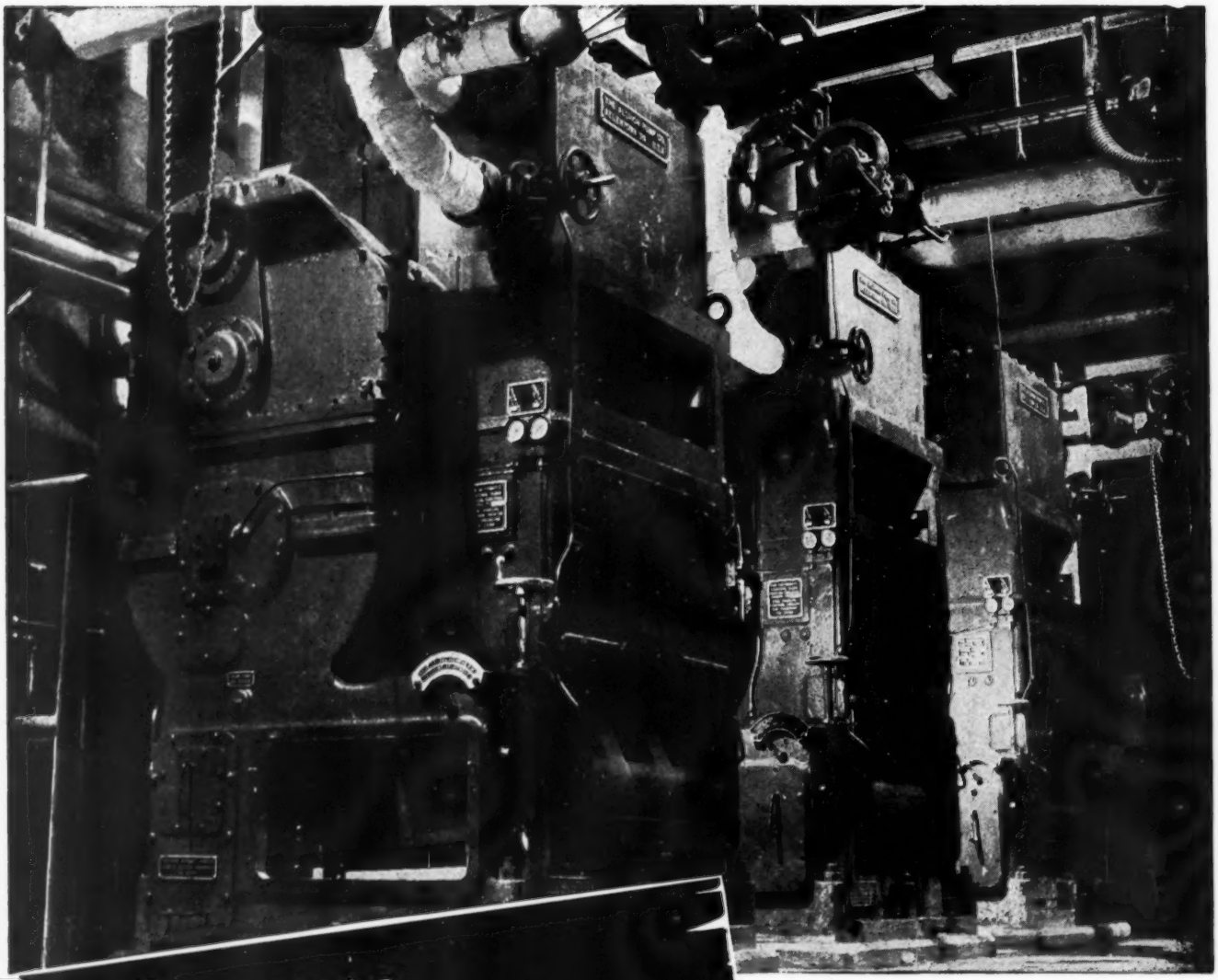
Many well-known manufacturers install Coppus "Blue Ribbon" Steam Turbines on original equipment. They know Coppus quality will protect the reputation of their own products. The Coppus Turbine is also being used on many U. S. Destroyer Escorts, all Casablanca class aircraft carriers and 90% of all Landing Ship Docks.

Like all Coppus "Blue Ribbon" products (blowers, ventilators, gas burners, etc.), the Coppus Steam Turbine is a precision-made product, with accuracy controlled by Johansson size blocks. Every turbine is dynamometer-tested before shipment.

More than 85% of all orders since 1937 have been repeat orders.

Write for Bulletin 135-9. Coppus Engineering Corporation, 402 Park Avenue, Worcester 2, Mass. Sales offices in THOMAS' REGISTER. Other Coppus "Blue Ribbon" Products in SWEET'S, CHEMICAL ENGINEERING CATALOG, REFINERY CATALOG.

ANOTHER
COPPUS
"BLUE RIBBON" PRODUCT



Increase POWER PLANT EFFICIENCY with

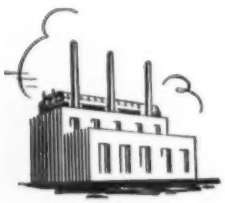
...ALDRICH-GROFF CONTROLLABLE CAPACITY "POWR-SAVR" PUMPS

Aldrich-Groff pumps on unit feed systems eliminate pressure and power losses common to throttling-type feed regulating valves and offer advantages of feed system simplicity, efficiency and mechanical reliability for small and medium installations at medium and high steam pressures.

Equally important overall power savings are effected by Aldrich-Groff pumps on de-superheater feed service in connection with high pressure topping units for power stations of any size.

The three Aldrich-Groff 3¼" x 0 to 6" variable stroke vertical triplex pumps shown above are in service in a mid-western central station employing the unit system for main boiler feed. Two are driven by constant speed motors and the third by a constant speed steam turbine. Power consumption is almost directly proportional to pump delivery.

The 6" stroke—3¼" plunger pump is a 100 HP unit and when operating at maximum speed can deliver 70,000 pounds of feed water per hour against 1025 pounds boiler pressure.



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for bulletins and material giving full details, sizes and ratings of Aldrich-Groff Pumps.

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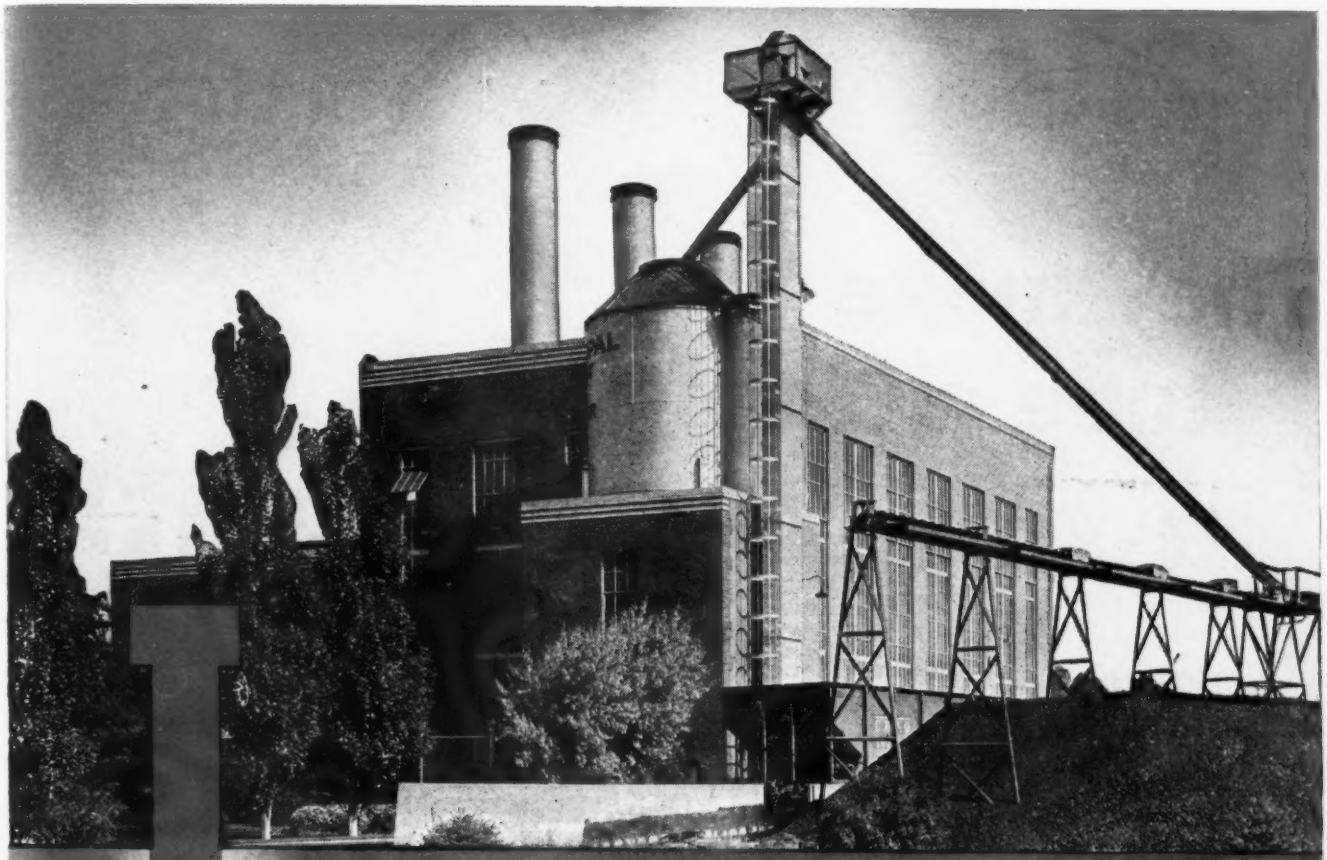

JEFFREY ENGINEERING *for Material Handling*

COVERS EVERY INDUSTRY

Send for Catalog No. 778

POWER PLANTS

The ultimate cost of coal cannot be determined until the coal is consumed . . . its power utilized . . . and the ash residue disposed of. Handling that coal from mine to track to power plant to ash pile is a major item in that final cost. Over sixty-five years of engineering experience is behind Jeffrey Coal and Ashes Handling Equipment. Whether your plant is small or large, Jeffrey can show you savings with an almost unlimited assortment of Material Handling Machinery.

The JEFFREY MANUFACTURING COMPANY
ESTABLISHED 1877
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Baltimore 1, Birmingham 3, Boston 16, Buffalo 2, Chicago 1, Cincinnati 2, Cleveland 13, Denver 2, Detroit 13, Huntington 19, Marion, Houston 5, Milwaukee 11, New York 7, Philadelphia 3, Pittsburgh 22, St. Louis 3, Salt Lake City 1, Scranton 3

They make tube cleaning a one-punch fight!

One pass through a tube does a clean job with the Elliott (Lagonda Type) 1300 Series tube cleaner. No need to run the motor while the cleaner is being pulled back. No need to put it through a second time.

It's a matter of *power*—of advanced motor design that has the stuff to drive the cutter head at the speed required to smash and clear out *all* the scale in one *trip*, fighting all the way.

Short, handy and packed with power like a mule's hind leg, the streamlined, bullet-shaped body of the 1300 Series motor can get around tube curves and bends with ease. Armed with the correct Elliott head, it is everywhere making the tube cleaning chore a simple speed job instead of a disagreeable task. You can't duck tube cleaning, but here's a cleaner that will take most of the grief out of it. Write for the bulletin.

THE NEW LUBRICATION SYSTEM

that does more than just *hope* that oil will get up to the front bearing. It actually *puts* it there. This is only one of a number of features, some of them minor, but all adding up to new refinement, new power, new stamina, in a tube cleaner already old in high reputation.

ELLIOTT COMPANY
***Lagonda Division*, SPRINGFIELD, O.**
Plants at: JEANNETTE, PA. • RIDGWAY, PA.
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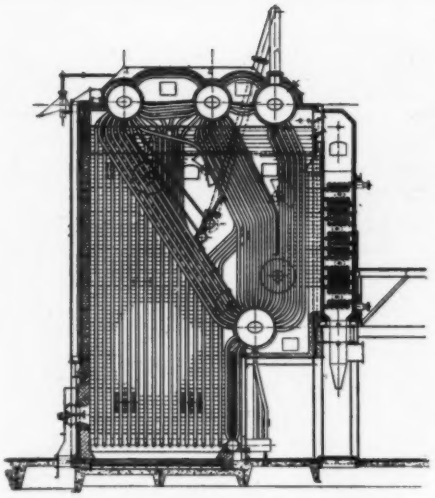
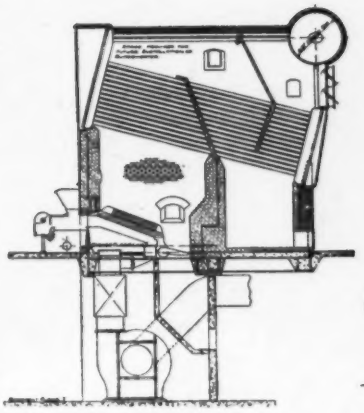
Y-242

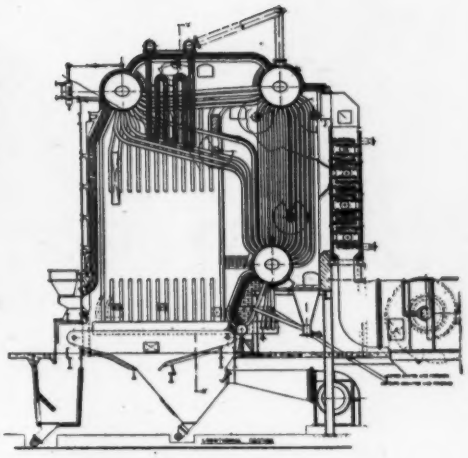
ELLIOTT 1300 SERIES CLEANER
for straight and curved tubes



4 Drum Water Tube Boiler

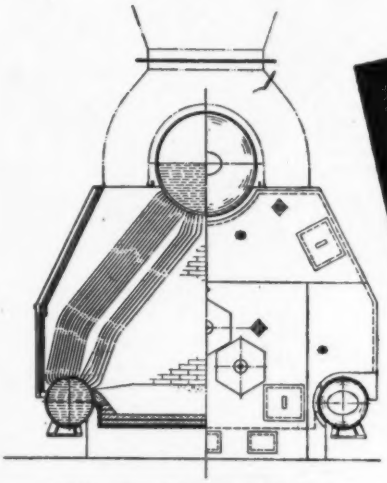


Horizontal Cross or Long Drum Water Tube Boiler

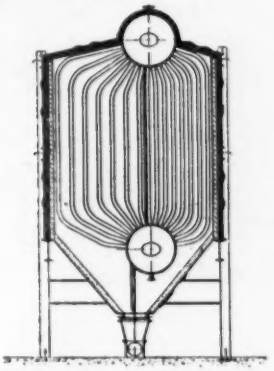


3 Drum "S" Type Water Tube Boiler

WICKES BOILERS

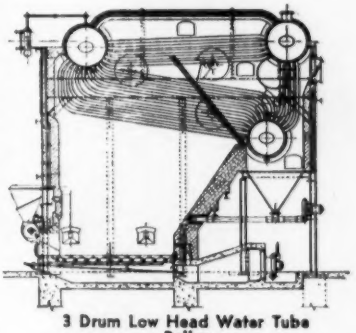


"A" Type Water Tube Boiler for Marine Use

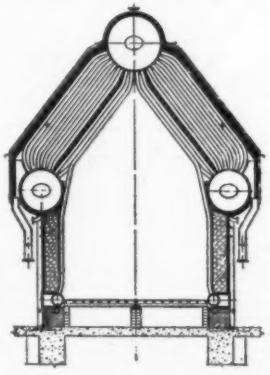


Wickes 2 Drum Waste Heat Installation

Boilers and pressure vessels designed and manufactured in our plant are converting steam loads into industrial energy in scores of important installations the world over. We have the engineers, manufacturing facilities, and skilled workmen to fill your requirements for boilers of any type up to 250,000 lbs. steam per hour and 850 psi. We also perform all types of heavy welded plate fabrication for oil, chemical, paper, and other industrial use. Send us your problems for expert consultation and recommendation. No obligation, of course.



3 Drum Low Head Water Tube Boiler

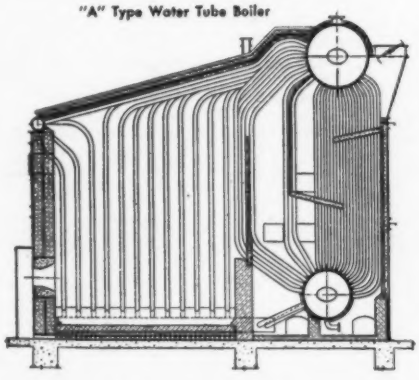


"A" Type Water Tube Boiler

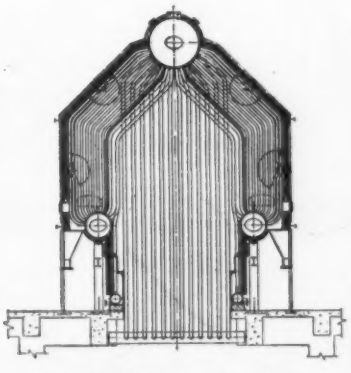
THE WICKES BOILER COMPANY

SAGINAW, MICHIGAN

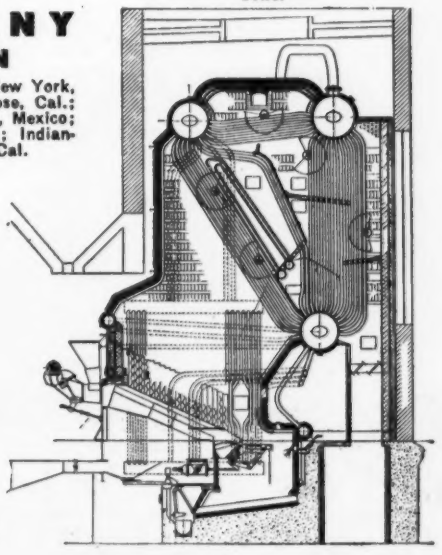
SALES OFFICES: Detroit, Mich.; Chicago, Ill.; New York, N. Y.; Milwaukee, Wisc.; Pittsburgh, Pa.; San Jose, Cal.; Tulsa, Oklahoma; Fort Worth, Texas; Mexico City, Mexico; Saginaw, Mich.; Portland, Oregon; Boston, Mass.; Indianapolis, Ind.; Baltimore, Maryland, San Francisco, Cal.



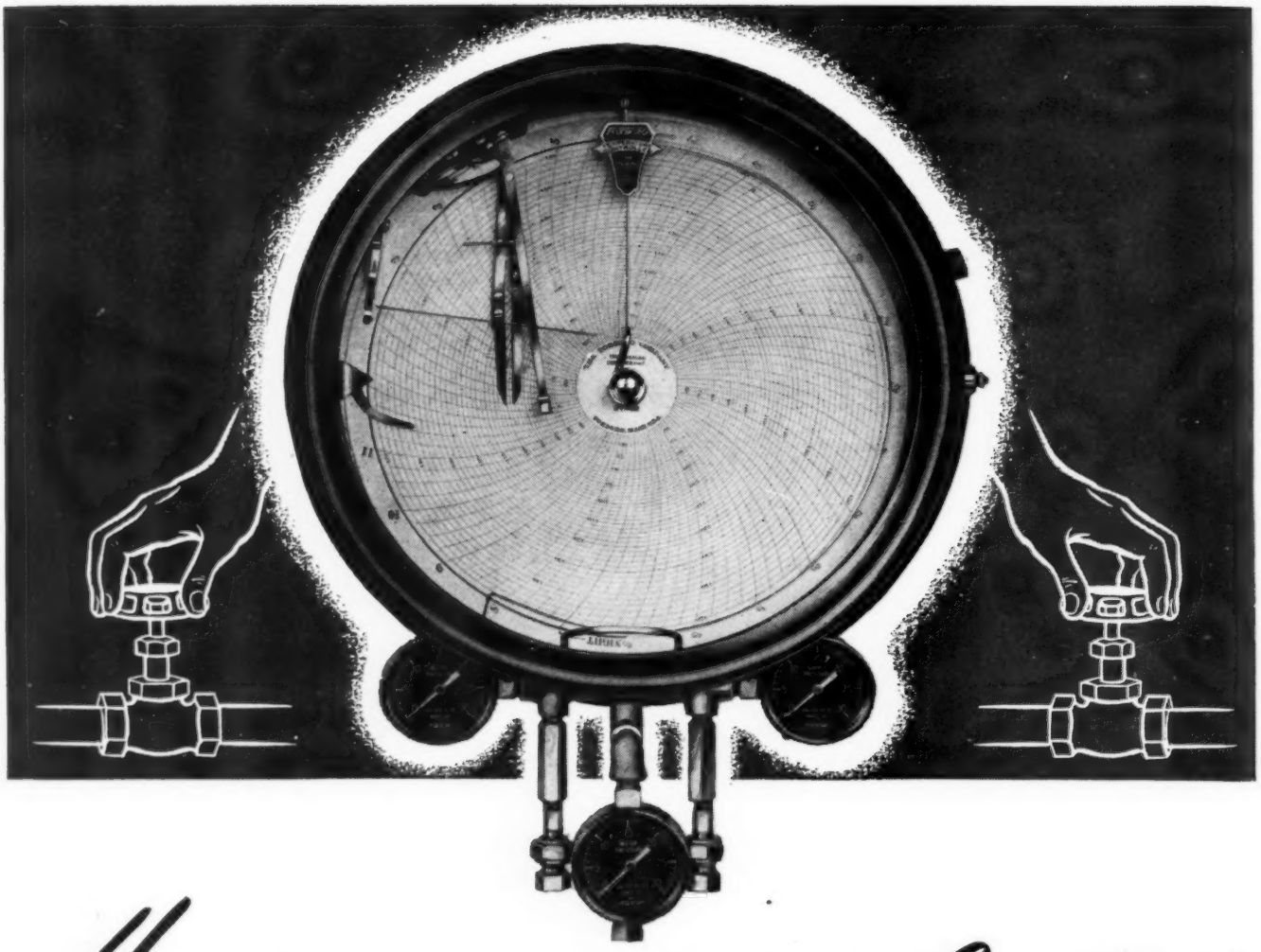
2 Drum Water Tube Boiler



Crown "A" Type Water Tube Boiler



3 Drum Water Tube Boiler



Here's "AMBIDEXTROUS" *Control*

THAT AUTOMATICALLY OPERATES TWO VALVES!

Wherever process temperature, pressure or humidity must be controlled by adjustments of two valves, the Foxboro Duplex Controller gives you two dependable, accurate "hands" that need no supervision. It combines 2 single-action valve control systems actuated by a single measuring system.

All you need to do is set the "high" and "low" indicators at desired points. The controller automatically "manipulates" one valve if the process condition reaches the high point; or the other valve at the low point.

What's more, both adjustments may be definitely fixed at specified degrees, percentages, or pounds-per-square-inch to maintain an exact differential between high and low points.

Typical advantageous uses of Foxboro Duplex Controllers are listed in the panel. Detailed information on their application to your problem may be obtained by sending a description of your process. Write **The Foxboro Company, 68 Neponset Ave., Foxboro, Mass., U. S. A.** Branches in principal cities.

TYPICAL APPLICATIONS

1. Dry Kilns – for humidity control. One "hand" of the Duplex Controller operates steam spray valve; the other adjusts the vent.

2. Air Conditioning – without supervision, a Duplex Controller accurately controls heating and cooling, or humidifying and de-humidifying.

3. Dryer Rolls (as in paper mills) – Foxboro Duplex Controller automatically controls two valves to utilize exhaust steam or live steam for greatest economy and uniform temperature.

4. Exothermic Processes, such as electroplating and polymerizing. Through accurate control of 2 valves, Duplex Control automatically adds or removes heat to maintain correct temperature.

FOXBORO
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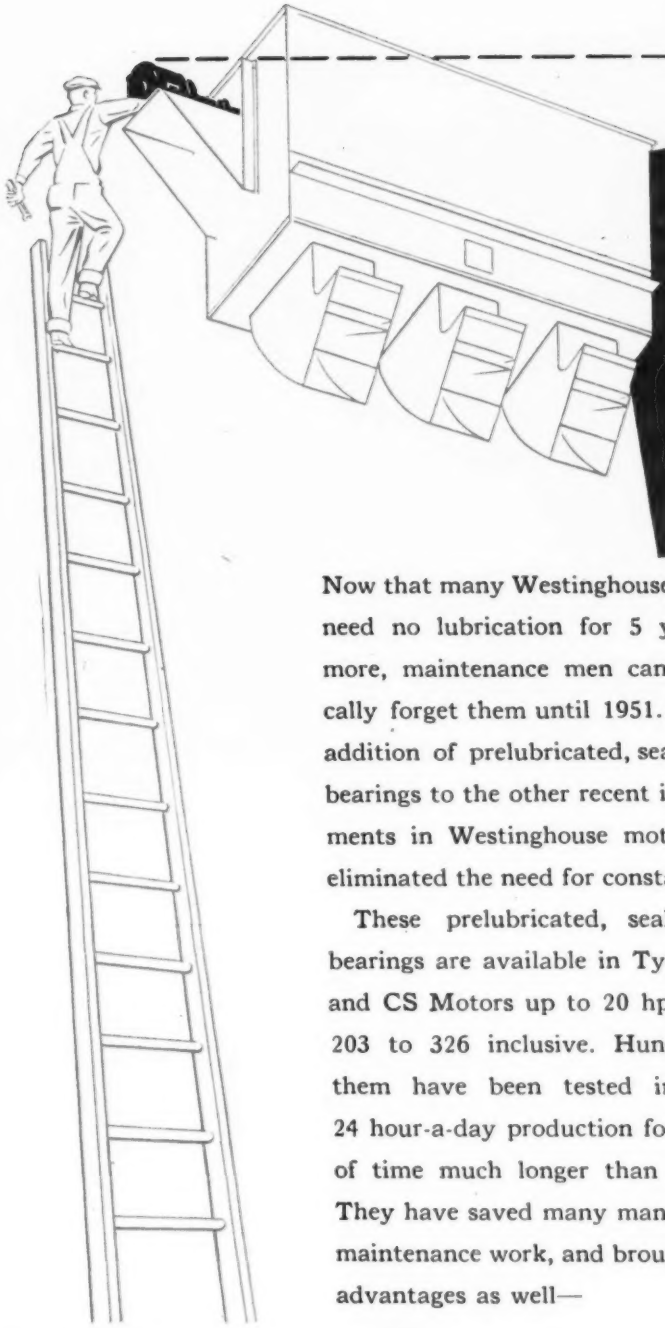
DUPLEX CONTROLLERS

INSTALL TODAY...



DON'T LUBRICATE until 1951!

Until 1951, there's no need to have anyone climb a ladder to lubricate this motor.

Now that many Westinghouse motors need no lubrication for 5 years or more, maintenance men can practically forget them until 1951. For the addition of prelubricated, sealed ball bearings to the other recent improvements in Westinghouse motors has eliminated the need for constant care.

These prelubricated, sealed ball bearings are available in Types CSP and CS Motors up to 20 hp, frames 203 to 326 inclusive. Hundreds of them have been tested in actual 24 hour-a-day production for periods of time much longer than 5 years. They have saved many man-hours of maintenance work, and brought other advantages as well—

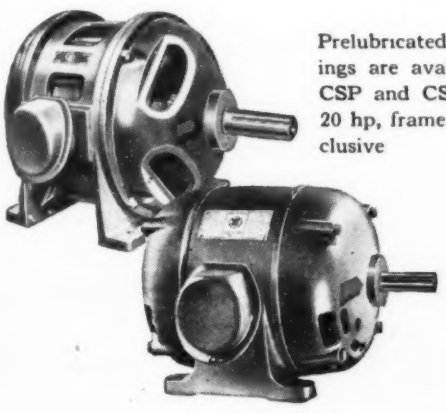
- No overgreasing
- No "skipped" bearings
- No grease contamination
- No grease seepage
- No unreplaced pipe plugs

This freedom from frequent lubrication brings also a greater freedom to engineers designing new equipment or laying out plants. They can now place motors most advantageously for their operation—unhampered by questions of accessibility and ease of greasing. For further details, write for Bulletin B-3554 and Descriptive Bulletins 3100-CSP and 3100-CS-1, to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

J-21377

Westinghouse

PLANTS IN 25 CITIES... OFFICES EVERYWHERE



Prelubricated, sealed ball bearings are available in Types CSP and CS Motors up to 20 hp, frames 203 to 326 inclusive

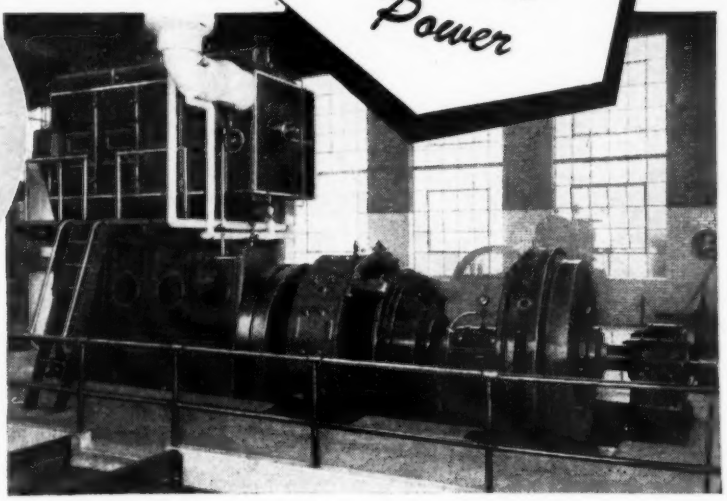
Squirrel Cage Motors

Another Westinghouse "first"—this label identifies motors that you "don't lubricate for 5 years or more"

Le Blond...

THE WORLD'S LARGEST MANUFACTURER OF A COMPLETE LINE OF LATHES

uses this
SKINNER "UNIVERSAL UNAFLOW" STEAM ENGINE
to Generate Electric Power



The 4-cylinder "Universal Unaflow" Steam Engine driving 600-kw. D-C Generator, and 500-kv.a. A-C Generator, in The R. K. Le Blond Machine Tool Company power plant.

THE R. K. Le Blond Machine Tool Company in Cincinnati is a glorious monument to its able founder, who, after serving at its head for 58 years, still occupies the position of Chairman of the Board. It is also a fine tribute to his character that many of his early associates are still with him. Mr. Le Blond has guided the destinies of his company, from the days when he worked with two assistants in one small room, to the present time when its renowned machine tools go from the huge present plant to all parts of the earth.

It is a matter of pride with us to have installed a "Universal Unaflow" Engine-Generator Unit in any plant with as fine a record as that of the Le Blond Company. It is doubly so when the engine has been selected by so competent and efficient a group of experts. No better qualified staff of engineers can be found today than those who work with The R. K. Le Blond Machine Tool Company, and it is a coincidence that in the early days Mr. Le Blond himself actually built steam engines.

In widely diversified industrial and institutional fields, more than two thousand power users attest to the economy of generating their own power with Skinner "Universal Unaflow" Steam Engines. An accurate estimate of your potential savings will be made by Skinner Engineers without any obligation or expense.

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For Over 75 Years, Doing One Thing Well—Building Steam Engines

SKINNER ENGINE COMPANY, ERIE, PA.

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112 TONS OF CRUSHED GLASS DAILY?

EASY WITH A TOUGH BWH BELT

PROBLEM: To haul 112 tons of crushed glass each 14-hour day — 365 days a year, and through drastic temperature changes.
SOLUTION: BWH "Bulldog" Belting, of course!

This rugged conveyor belting is made by the famous ROTOCURE process of continuous vulcanization that insures stamina and ease of operation, regardless of how abrasive the load. This BWH belt has run continuously since July 7, 1942, and . . , at a lower maintenance cost.

Through 65 years of leadership in the industry — BWH has pioneered the development of tough conveyor belts and other rugged products of dependability. Look to BWH for the solution to your tough problem!

HAVE YOU A JOB WHERE STAMINA COUNTS?

Bring us your toughest problems . . . we're specialists in solving them. Consult your nearest BWH distributor, or write to BWH direct.

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"Fugitives" from your power gang?

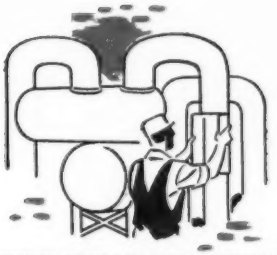
NATIONWIDE DISTRIBUTION— Warehouse stocks of the broad Carey line provide service regardless of job location.

CAREY INSULATION ENGINEERING SERVICE makes available the knowledge and experience of leading authorities.

Give a BTU a bare or poorly insulated pipe . . . and he'll "make a break." Multiply his "escape act" millions of times a day and you come to this conclusion: he's *wasting* a lot of fighting fuel you need.

Adequate insulation is the answer. And Carey simplifies that problem by offering you (1) a broad line of types, shapes and forms of insulation *plus* (2) the engineering ability to determine the one best insulation or combination of insulations for your job.

To apply Carey's 50-odd years of Heat Insulation engineering experience to your problem—just write—



TRAINED ERECTION AND SERVICE CREWS "make sure" the job is done right.

BROAD LINE FROM ONE SOURCE. No need to compromise with desired results. You get the right insulation for the job.

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COAL CRUSHING COST GOES DOWN *and* FIRING EFFICIENCY GOES UP *with American Rolling Ring Crushers . . . .*

American AC 3B Rolling Ring Crusher Installation at the Southern Indiana Gas and Electric Co. at Evansville, Ind.

ONLY AMERICANS HAVE THE SHREDDER RINGS

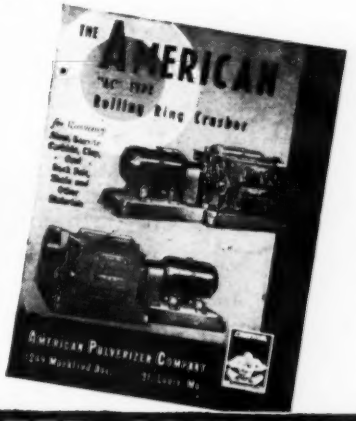
On the rotor multiple manganese shredder rings, each with 20 edges, split coal instead of crushing it to provide a uniform product with high tonnage at low cost. Each shredder ring revolves freely on its own shaft and deflects from tramp iron. No shear pins or conventional safety devices to bother with.

The installation at the Southern Indiana Gas and Electric Company has been in service three years without repairs or replacements having been made.

American Rolling Ring Crushers have an average operating cost of *less than 1¢ per ton*—including power, depreciation, labor and all overhead costs.

Their low cost dependable operation is proved in performance all over the world.

Americans are sturdily constructed yet compact and easily installed in limited headroom. Capacities up to 500 TPH.



Write for this informational bulletin.

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Originators and Manufacturers of Ring Crushers and Pulverizers

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Spiral-wound gaskets represent the logical approach to difficult sealing problems—BUT there's much more to it than this. Only in Flexitallic — the *original* spiral-wound gaskets — do you benefit from exclusive precision methods that permit winding to exacting tolerances which cannot be equalled elsewhere in the industry. Only in Flexitallic Gaskets do you get design that is specifically balanced with specific fitting and service requirements.

And only through individually engineered construction and exclusive patented features can you be assured of the dependable, trouble-free service for which Flexitallic Spiral-Wound Gaskets have been famous for over a third of a century. Write for catalog.

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GASKET COMPANY
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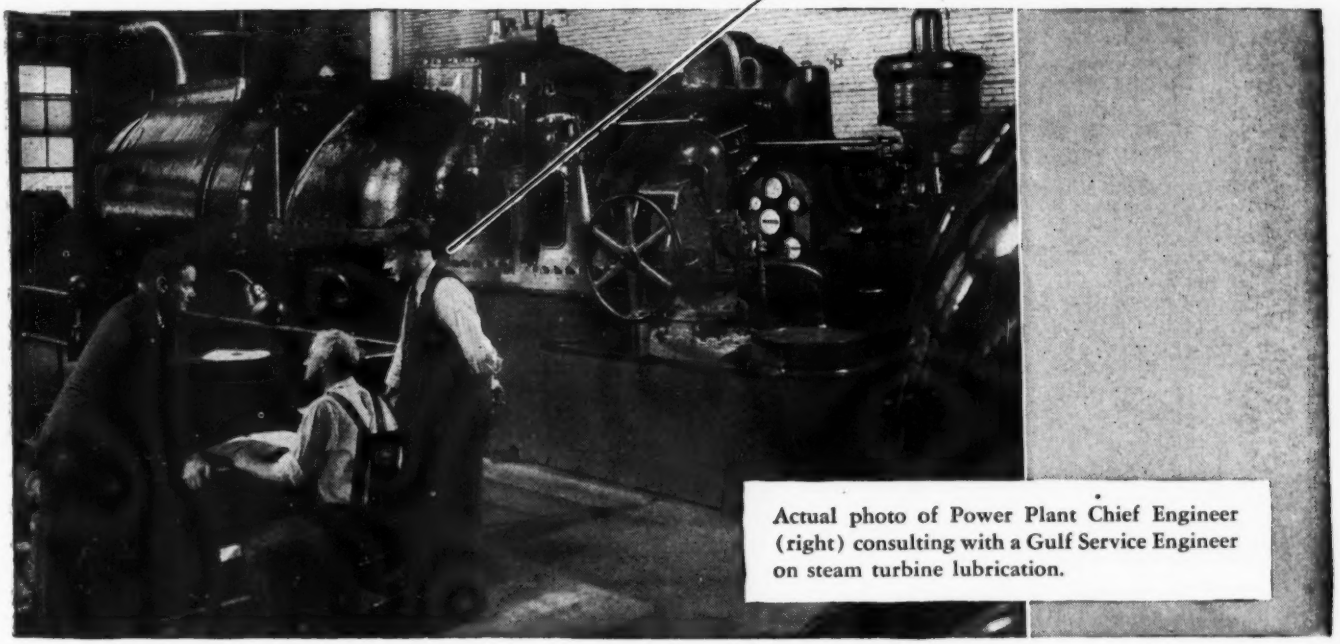
THE ANSWER TO 1001 DIFFICULT GASKET PROBLEMS

"We get more efficient lubrication with GULFCREST OIL"

says this Chief Engineer



Actual photo of Power Plant Chief Engineer (right) consulting with a Gulf Service Engineer on steam turbine lubrication.

"WHEN WE SWITCHED from a conventional type turbine oil to Gulfcrest, we gained more efficient lubrication," says this Power Plant Chief Engineer. "With Gulfcrest Oil we not only get maximum bearing protection, but also freedom from sludge. The neutralization number of this fine oil has stayed consistently below .06 during more than four years of service in our three units."

Here's the important reason for the outstanding record of Gulfcrest Oil in the turbine systems of hundreds of power plants from Maine to New Mexico: This top quality oil is superrefined by the Alchlor Process, which not only weeds out the sludge formers, but imparts to the oil greater ability to benefit from the special addition agents which give the oil improved characteristics.

Send the coupon below today for your copy of the new booklet which gives the complete story of Gulfcrest Oil and of the Alchlor superrefining Process.

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All industrial equipment and supplies will have to be purchased with their cost-cutting possibilities a prime consideration. Equipment must *save* while it *serves!*

Wire rope in your business must do its part in cutting overhead too. Meeting competitive business, equipped with Roebling "Blue Center" Steel Wire Rope, is a *sure* step in this direction. The staying power and reserve strength of *any* Roebling Wire Rope, regardless of its type, is real economy over a long period of operation.

Unsurpassed facilities, research and practical engineering of America's pioneer wire rope maker, assure you top service in installation or maintenance. Roebling Wire Rope will help to remove the danger of costly shutdowns due to replacements . . . will help you profitably meet the coming years of competition.

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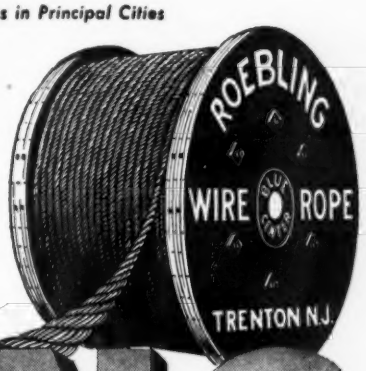

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Equipment isolated by Heacon is available for maintenance as soon as the unit comes off. Valuable hours are gained. Cooling is accurately controlled by Heacon in the by-pass avoiding temperature strain. The maintenance crew will finish their work hours or even days sooner because they are not exposed to a "snow storm" of ash and soot. Only Heacon shuts tight enough to accomplish this and yet allow controlled ventilation for proper breathing.

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The Royal never needs adjustment

Because there's nothing to adjust

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The dependability of the ROYAL is proven by the fact that *more* ROYALS are sold than any other Flush Valve. It is "standard equipment" with discriminating builders and owners throughout the country. In fact, entire school systems, hotel chains, hospitals, industrial institutions, etc., use ROYALS exclusively.

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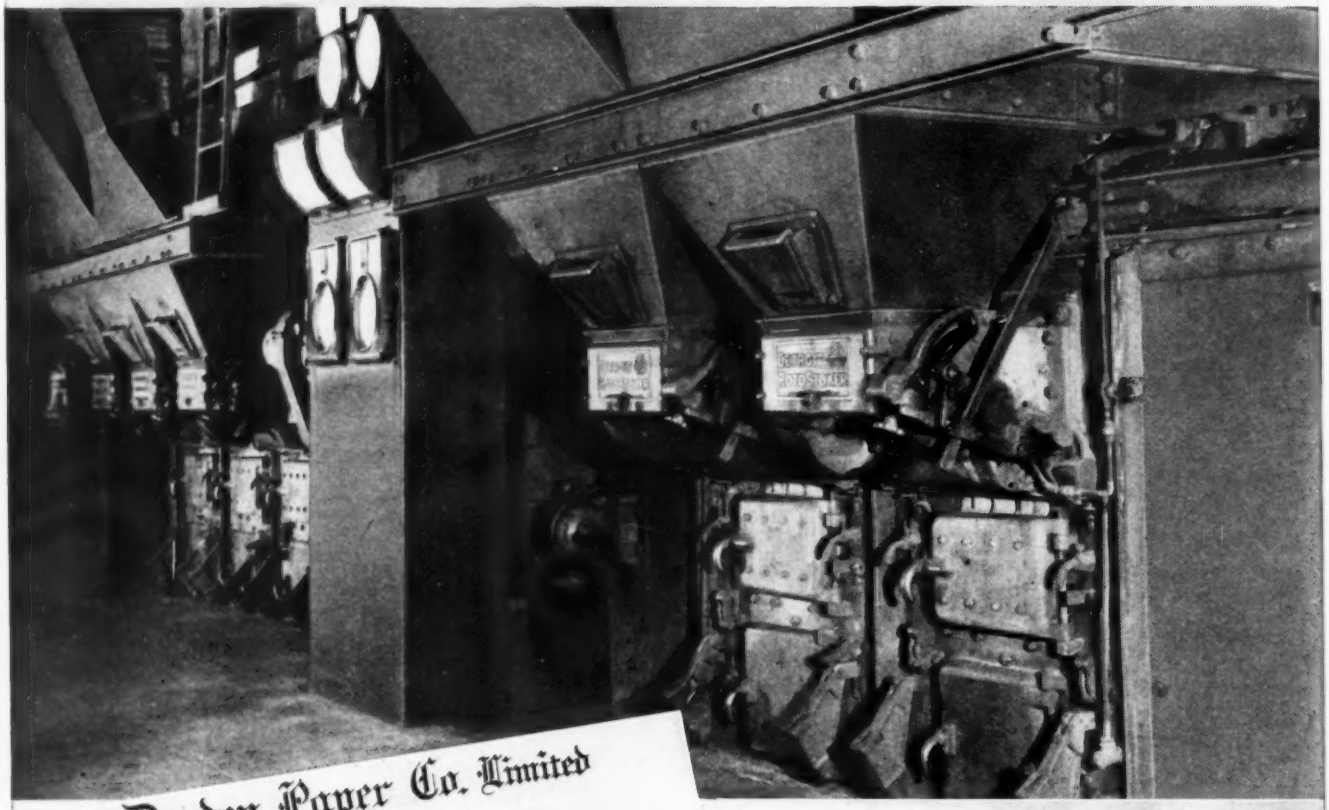
— Repeats —
THREE INSTALLATIONS
DETROIT ROTOSTOKERS



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DETROIT STOKER COMPANY

Fifth Floor, General Motors Building, Detroit, Michigan • Works at Monroe, Michigan
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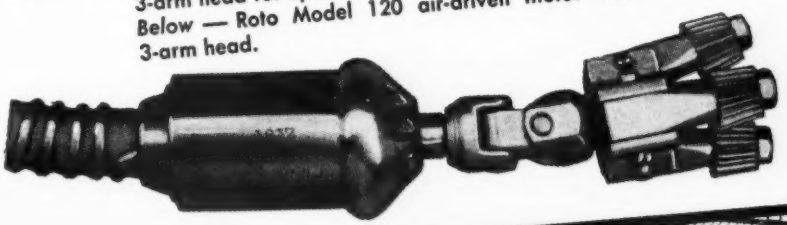
ROTO TUBE CLEANERS

for Type C, Three-drum ERIE CITY BOILERS

Boilers of the three-drum type totalling more than a quarter-million horsepower have been built by Erie City Iron Works for high-pressure service. Since tubes are of uniform diameter, only one size tube cleaner is required to maintain the unit at top efficiency. You can order Roto Tube Cleaners for these or any other standard type boilers by wire or phone. Most orders can now be shipped on day received.

Above — Roto Model 22 water-driven motor with 3-arm head for operation where air is not available.
Below — Roto Model 120 air-driven motor with 3-arm head.



ROTO Division of ELLIOTT COMPANY

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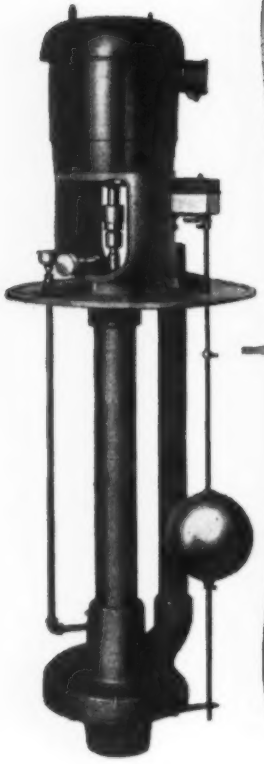
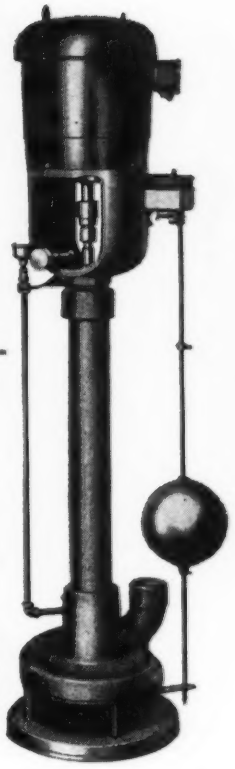


DEMING

Vertical Sump Pumps



The diversified line of Deming Sump Pumps offers an exceptional range of selectivity to meet practically every wet or dry pit type of installation.

Capacities of Deming Sump Pumps range from 10 g.p.m. to 3200 g.p.m. with heads up to 120 feet and speeds from 860 to 1750 r.p.m. for motor drive. Duplex units are designed for conditions where extra precautions must be taken to assure continuous service. All units have important features of construction such as the impeller which is adjustable for capacity, head and wear.

16 PAGES OF USEFUL INFORMATION...WRITE!

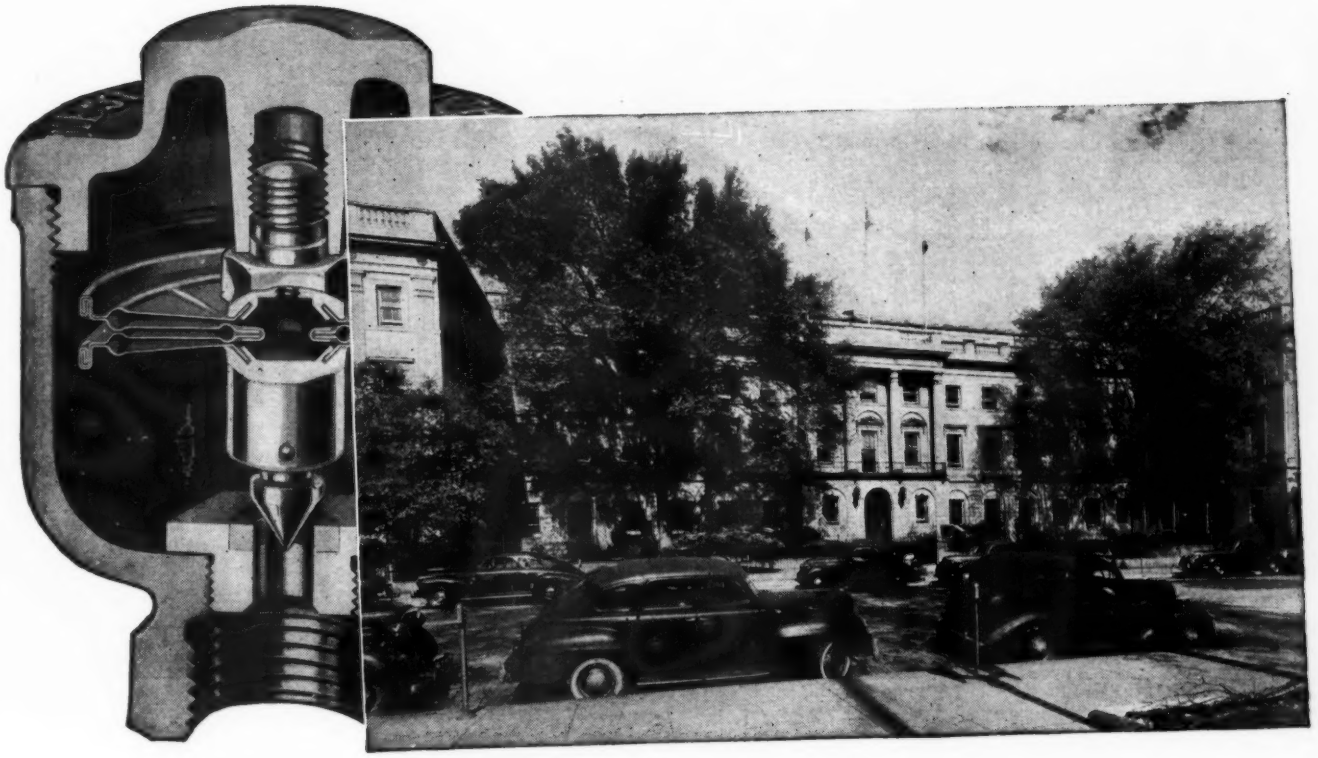
Ask for Bulletin 4603 which includes complete details on standard construction of Deming Sump Pumps, performance Tables for all types and capacities of standard units, information regarding Duplex units, specifications, and other helpful data.

THE DEMING COMPANY • SALEM, OHIO

DEMING

THE COMPLETE LINE

PUMPS AND WATER SYSTEMS



Twenty-six years' service! Initial installation in 1918 . . . interior "thermostats" replaced in 1944! That's the record of Webster Thermostatic Traps in the office building of the Chase Brass & Copper Co., Waterbury, Conn.

Long Service from Webster Traps

The quarter-century plus record of Webster Traps dated above is not an isolated instance. In our files are many other records of ten . . . fifteen . . . twenty years and more . . . varying with service conditions, pressure, local water and quality of operating standards.

Webster Radiator Traps are built to give extra years of service — design, quality materials, precision manufacture and careful inspection are the "reasons why".

Traps at lower *first* cost do not mean a saving. Actual cost is determined by length of service . . . And Webster Traps are outstanding for years of service per dollar.

There's no waste of "live" steam because Webster Radiator Traps hold steam in the radiator till it has given up all its useful heat. They do not open too soon, allowing uncondensed steam to escape into the returns. Nor do they close too soon, holding up condensate. Webster Radiator Traps mean quick, continuous and complete discharge of air and condensation.

If your radiator traps need replacement, get the longest-lasting trap available. For full information on Webster Traps, consult the nearest Webster Representative. Or write us direct.

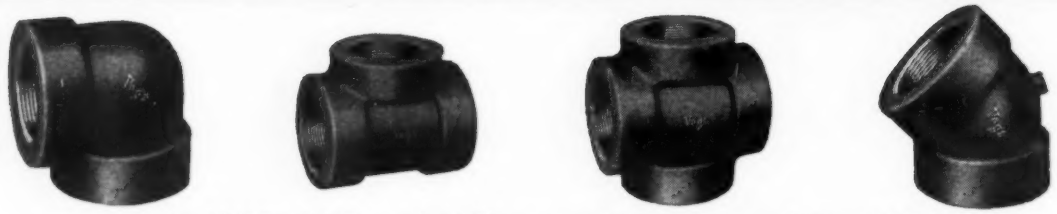
WARREN WEBSTER & CO., Camden, N. J.
Pioneers of the Vacuum System of Steam Heating
Representatives in principal cities : : Darling Bros., Ltd., Montreal

Fuel-Saving Starts With CONTROL

AUTOMATIC Webster Heating Systems

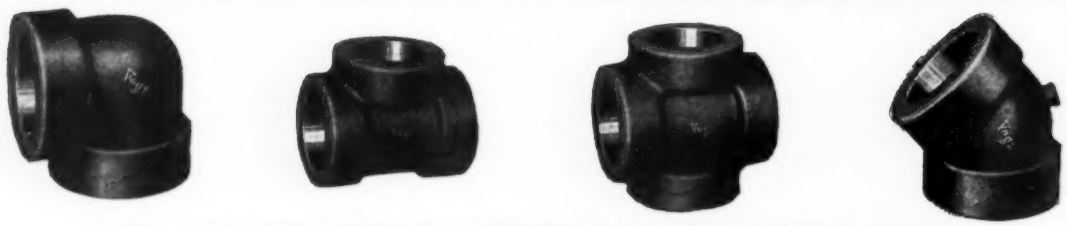
STRENGTH

for Safety and Long-Time Service



For 2000, 3000 and 6000 pounds service — Sizes 1/8" to 6"

SCREW END TYPE



For schedules 40, 80 and 160 pipe — Sizes 1/8" to 4"

SOCKET WELD TYPE

Vogt Ells, Tees, Crosses, etc., are forged from carbon steel or various alloys to meet specific operating conditions. Catalog F-8 will aid you in their selection and proper application.

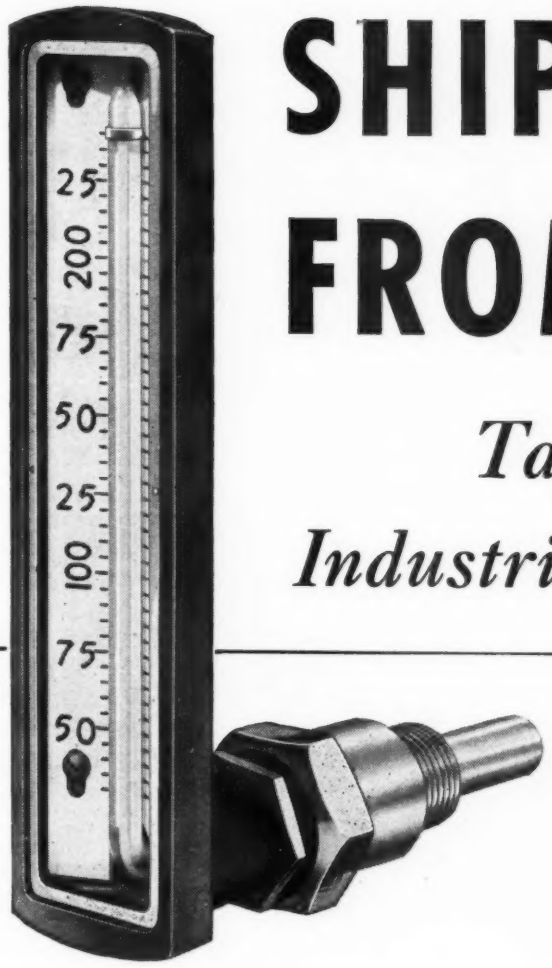
Shocks and stresses imposed by high pressures and high temperatures are taken in their stride because Vogt fittings are uniform in structure, fine grained, and free from porosity . . . the superior product of laboratory controlled materials and giant forging hammers and upsetters. These properties also give higher resistance to erosive and corrosive conditions, thereby adding to service life expectancy in steam plants, petroleum refineries, chemical plants and related industries.

HENRY VOGT MACHINE CO., INC.
Louisville 10, Kentucky
BRANCH OFFICES: NEW YORK • PHILADELPHIA • CLEVELAND • CHICAGO • DALLAS

Vogt DROP FORGED STEEL FITTINGS

NOW READY FOR SHIPMENT FROM STOCK

Taylor 5-Inch Industrial Thermometers



Instruments for indicating, recording and controlling temperature, pressure, humidity, flow and liquid level.

WE made thousands of these compact, sturdy Taylor Industrial Thermometers for the Navy and Maritime Commission and for war industry. And we've maintained our wartime production level so that you can have the thermometers you want immediately. They're ideal for checking temperatures in limited space or wherever vibration is a problem.

RECOMMENDED FOR:

Diesel engines
Air compressors
Lubricating oil lines on motors, turbines, etc.
Generators
Reduction gears
Small diameter brine, water and steam lines

3 Times Easier to Read. Patented "Binoc" tubing (pronounced Buy-Noc) gives wider angle of vision and excellent magnification of mercury column. Bold black figures and graduations contrast with white scale.

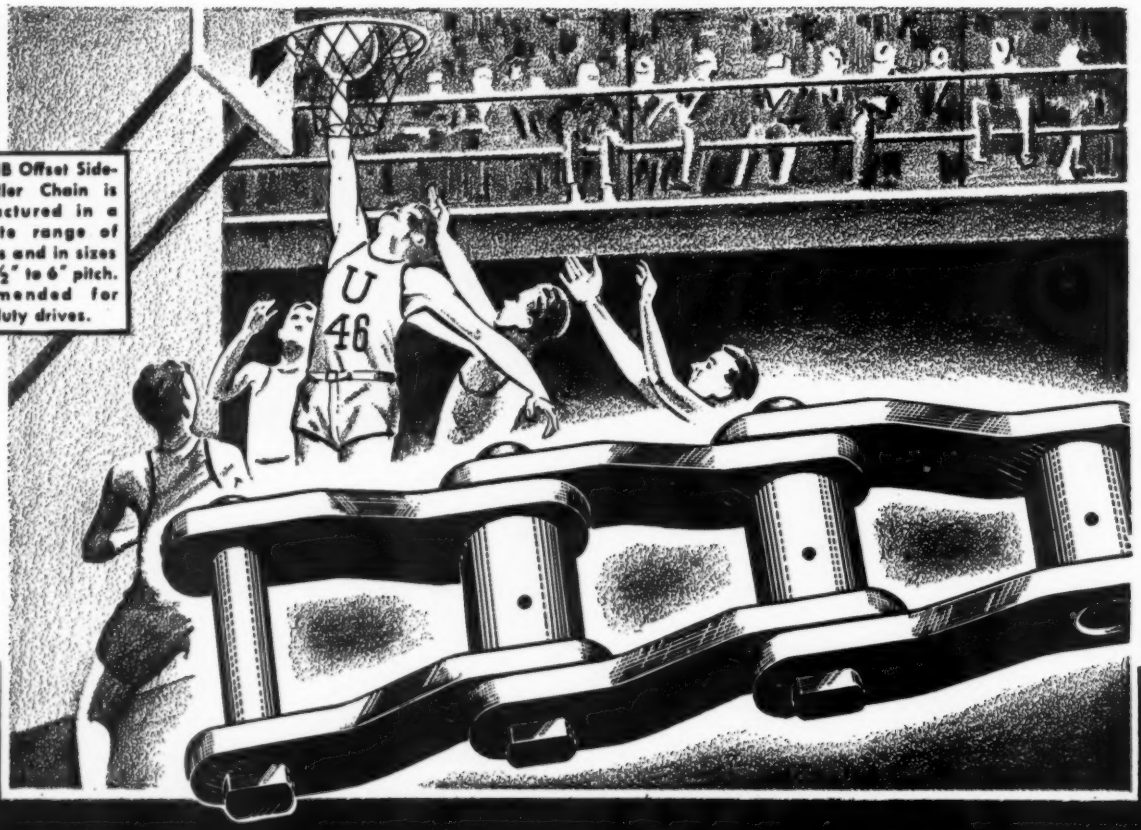
Sturdy Compact Case . . . One-piece, V-shaped casting. Rattleproof glass front. No separate front or top cap to loosen under vibration.

Variety of Stem Forms . . . Permit instruments to be properly installed yet insure frequent easy reading.

Order through your regular supplier or write to us for details. Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada.

ARMY NAVY

Taylor Instruments
MEAN
ACCURACY FIRST
IN HOME AND INDUSTRY



Union HB Offset Sidebar Roller Chain is manufactured in a complete range of strengths and in sizes from 1½" to 6" pitch. Recommended for heavy duty drives.

TWO POINTS FOR SPECIALIZATION

☆ Invariably the college basketball teams in the running for the national championship have giant centers who repeatedly demonstrate that extra inches in height result in extra points in the final score.

Two points can also be made in behalf of the specialization from which Union Chains benefit. Point One: Because we confine ourselves to the manufacture of a complete line of steel chains, sprockets and flexible couplings, many customers regard Union as their first choice in chain. Point Two: Because we manufacture a complete line of chains, we are compelled to have efficient production equipment for every phase of chain manufacturing which frequently results in better chain service. Give Union the opportunity to score with you on your next chain requirement.

The Union Chain and Manufacturing Company, Sandusky, Ohio, U. S. A.

Catalog A-2 covers Drive and Conveying Chain. B-2 covers Finished Steel Roller Chain. FC-1 covers Flexible Couplings. Ask for your copies.

Union Chains for Every Application

Drive and Conveying Chains and Sprockets

- Bridge Chain
- Combination Malleable Iron and Steel Chain
- HB (hardened bearing) type chain
- BP (bar and pin) type chain

★

Finished Steel Roller Chains and Sprockets

- All manufacturer's standard, size ⅜ in. to 2½ in. pitch
- Single and Multiple Strands
- Extended Pitch Series in sizes 1¼ in. to 4 in. pitch

★

Silent Chain and Sprockets

All sizes ¾ in. to 1½ in. pitch

★

Flexible Couplings

- Roller chain type
- Silent chain type

UNION CHAINS

What 0.04% Phosphorus Does To Your Dezincification Problem

Plain Admiralty Metal has almost all the properties for successful condenser and heat exchanger tube service that are needed to meet many power plant and oil refinery applications . . . but it has one weakness — fair to poor resistance to dezincification.

Under certain conditions, its brass content is gradually replaced by a spongy, porous copper deposit, locally (plug type) or uniformly over the tube (layer type).

To overcome this problem . . . and still retain the high corrosion resistance of plain Admiralty . . . Scovill *Service in Metals* developed Phosphorized Admiralty*. This is the alloy that Scovill engineers are recommending for many types of power plant and oil refinery service where dezincification of plain Admiralty has been observed or anticipated.

Many Times Greater Life

By inhibiting dezincification, Phosphorized Admiralty offers much longer service life. This improvement is brought about by a very slight change in the alloy composition — the addition of approximately 0.04% phosphorus. There is no appreciable difference in the structure or mechanical properties between regular and Phosphorized Admiralty as shown by the photomicrographs and graph at the right. There is no impairment of the metallurgical, physical and otherwise excellent corrosion-resistant properties.

Experience of Scovill customers has shown that in cases where dezincification has been troublesome, a change to Phosphorized Admiralty extends service life.

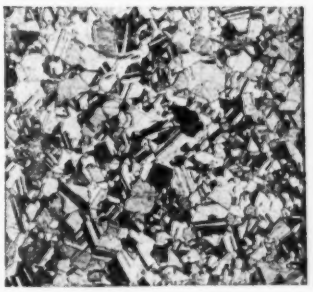
*"Phosphorized Admiralty Tubes" for condenser and heat exchanger service are covered by patent 2,224,095 and can be legally supplied only by Scovill Manufacturing Company, the owner of this patent.

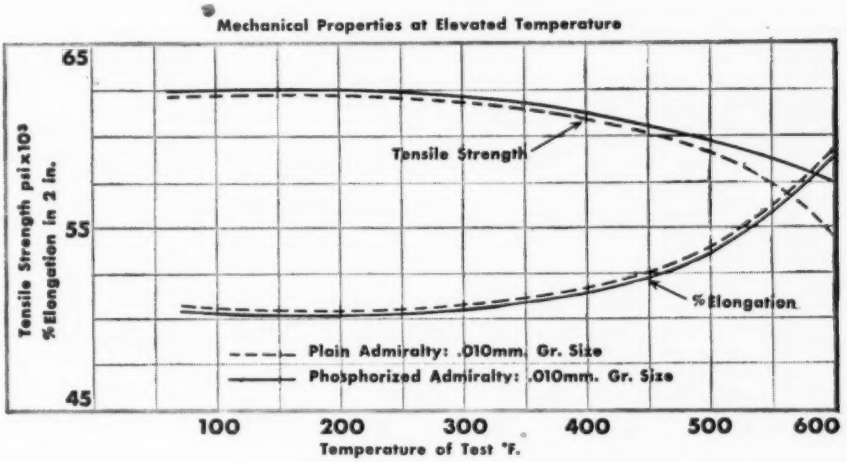
Other Scovill Services

Service in Metals, which includes the development of new alloys to meet changing service conditions and also individual study of specific customers' problems, is one of three Scovill services, well-known throughout Industry. *Service in Men* provides specialized advice on tube problems, installation aids and "follow-up" services. *Service in Manuals* offers valuable literature on condenser and heat exchanger tubes. For a copy of our Condenser Tube Booklet, address Scovill Manufacturing Company, 13 Mill Street, Waterbury 91, Conn.

Top: Plain Admiralty.
Bottom: Phosphorized Admiralty

75 x magnification.
Average grain size .035 min.





Plain Admiralty		Phosphorized Admiralty	
Copper	70.0 — 73.0	Copper	70.0 — 73.0
Tin	0.90 — 1.20	Tin	0.90 — 1.20
Lead	0.075 max.	Lead	0.075 max.
Iron	0.06	Iron	0.06
Phosphorus		Phosphorus	0.10 max.
Zinc	remainder	Zinc	remainder

Scovill
MANUFACTURING COMPANY
WATERBURY 91, CONN.

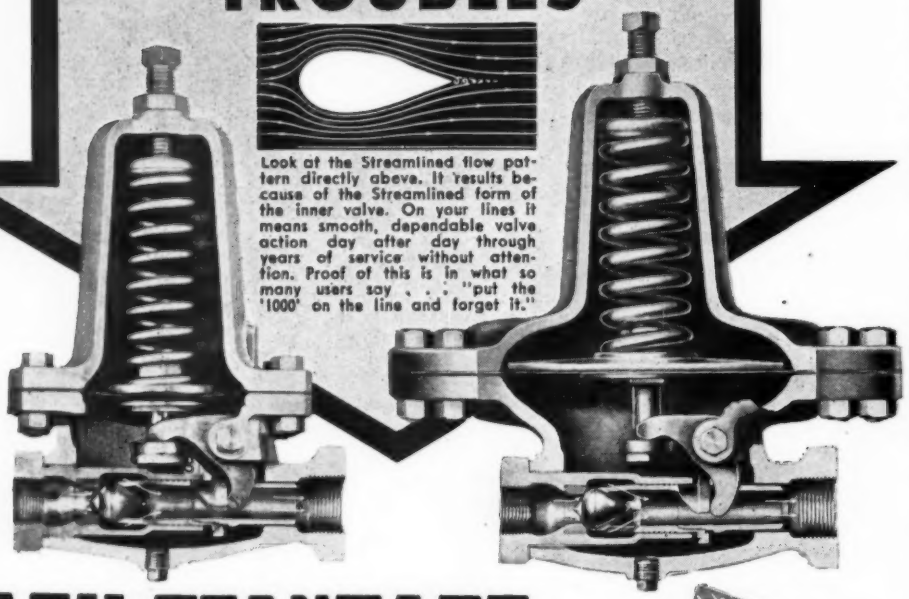
SCOVILL CONDENSER TUBES

ONE PRODUCT . . . THREE SERVICES

Service in Manuals . . . Service in Metals . . . Service in Men

HERE'S HOW PROCESSING LINES ARE *Fortified* AGAINST VALVE TROUBLES

Look at the Streamlined flow pattern directly above. It results because of the Streamlined form of the inner valve. On your lines it means smooth, dependable valve action day after day through years of service without attention. Proof of this is in what so many users say . . . "put the '1000' on the line and forget it."



CASH STANDARD *Streamlined* TYPE 1000 PRESSURE REDUCING VALVES

When you put this Streamlined construction on your lines you have no complicated parts to get out of order, no small ports or passages to clog up. There are no close fits. It's straight line flow all the way — flow that gives you maximum capacity, close delivery pressure control, and tight closures — flow that saves you money all along the line — flow that means elimination of failures — speedier production and no spoilage.

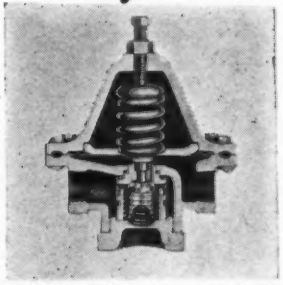
BULLETIN 962—features the CASH STANDARD Streamlined Type 1000 Pressure Reducing Valve—illustrates the streamlined construction and tells why you get exceptionally long, trouble-free, low-cost performance. Points out why you get no turbulence and therefore can meet peak demand at all times. Explains why straight-line flow gives you maximum capacity, close delivery pressure control, and tight closure..'

CASH STANDARD CONTROLS.. VALVES

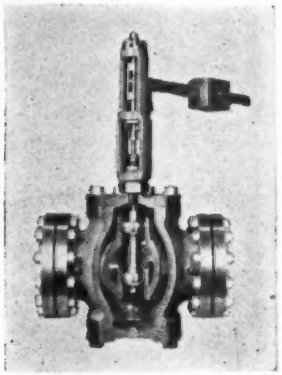
A. W. CASH COMPANY
DECATUR, ILLINOIS

BULLETINS AVAILABLE ON OTHER CASH STANDARD VALVES

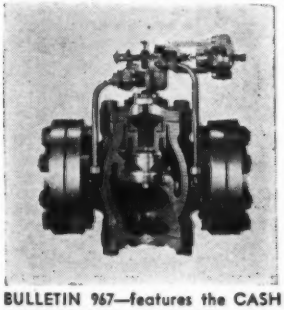
Send for them



BULLETIN 950—features the CASH STANDARD Type D Single Seat pressure Reducing and Regulating Valves for use with most fluids. Shows simple inner working parts that save in maintenance. Diagram explains how valve works. Blueprint shows simplicity of installation.



BULLETIN 965—features the CASH STANDARD "42" Series—a complete line of balanced lever valves for handling almost anything that will flow through a pipe except some injurious chemicals. Two full pages show 16 installations with descriptions.



BULLETIN 967—features the CASH STANDARD Tye 11 Condenser Water Regulator — self-contained — pilot-operated for controlling the flow of cooling water to condenser coils. Used with water or air —with any gas or oil that is non-corrosive—and with all refrigerating fluids. Blueprints show installation at outlet of condenser and at inlet. Capacity charts are shown.

REPUBLIC ELECTRUNITE BOILER TUBE

It's Republic's improved process of electric resistance welding . . . a process in which tremendous electrical energy combines with pressure to fuse together the clean edges of a cold-formed tubular shape without the addition of any metal. The ELECTRUNITE Process of welding and normalizing produces a sound tube with a weld area identical with the rest of the tube wall.

In thousands of tests, many conducted by independent, impartial research laboratories, Republic ELECTRUNITE Boiler Tubes *repeatedly* have demonstrated their ability to withstand pressures far greater than those which might be encountered in the most severe service.

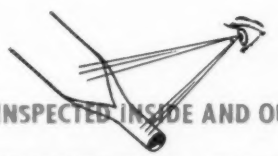
But there are other reasons, too, why more than 150,000,000 feet of ELECTRUNITE Pressure Tubes have been installed in all types of steam generating and heat transfer equipment.

These *modern* boiler tubes are *clean.* Because they are free of scale, there is less danger of localized corrosion causing premature tube failure and costly retubing down-time.

Many cost-wise users prefer Republic ELECTRUNITE Boiler Tubes, because they are consistently uniform in diameter, wall thickness and roundness —qualities which speed up retubing and get vitally needed equipment back on the job in a hurry.

NOW is the time to investigate fully these and the many other advantages of *dependable* ELECTRUNITE Boiler Tubes. Write directly to:

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION • CLEVELAND 8, OHIO
Export Department: Chrysler Building, New York 17, New York



Republic ELECTRUNITE Boiler, Condenser and Heat Exchanger Tubes are made from highest quality flat-rolled steel, both sides of which are open to close visual inspection. Thus, the surface which becomes the inside wall when formed into tubing is free from hidden defects.

Republic
ELECTRUNITE
Reg. U. S. Pat. Off.
BOILER, CONDENSER AND HEAT EXCHANGER TUBES

TROY-ENGBERG

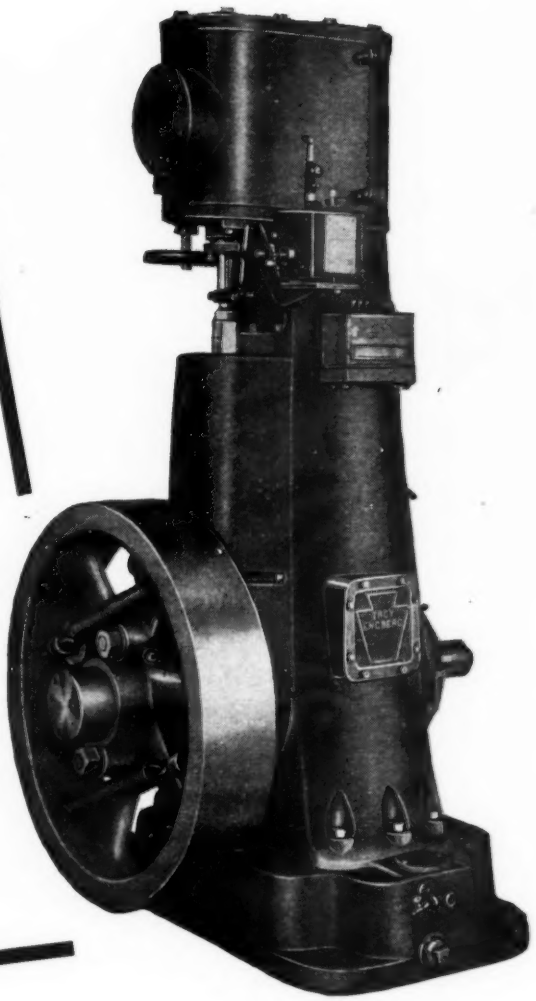
★ ★ ★

POWER That Soon Becomes Almost "Free" POWER

By "free" power, we mean that in a relatively short time the Troy-Engberg Steam Engine has completely paid for itself and from then on delivers power at so little cost as to be almost negligible. It can do this because it operates on steam intended primarily for processing or heating. It extracts the power and exhausts most of the heat units. It is what we call By-Product Power.

Low Cost By-Product Power has been responsible for placing the Troy-Engberg Steam Engine in thousands of plants driving stokers, pumps, compressors, fans, generators and other equipment. Why not investigate its possibilities for your plant?

Send for our New Bulletin No. 306



TROY ENGINE & MACHINE CO.

ESTABLISHED 1870

2512 RAILROAD AVENUE, TROY, PENNSYLVANIA

"Social Security" for your Products

AT ONLY A FEW CENTS A DAY!

923 Sylphon Regulator for controlling process temperatures. Hand-wheel adjustments. Sylphon Bellows diaphragm. Valve sizes ½" to 4" incl.

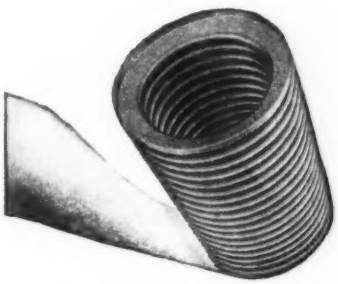
● When today's "sellers" market dissolves in the face of tomorrow's heated competition . . . when consumers again shop for value and price . . . will your products have the qualities necessary to secure their future success?

Better make sure now . . . by replacing old and costly "rule of thumb" process control methods with Sylphon automatic controls.

The No. 923 Sylphon Temperature Regulator shown on this page is widely used in industry to control steam supply to processing equipment where uniform temperature must be maintained day after day. Built to last indefinitely . . . sturdy, compact, self-contained . . . not dependent on compressed air or electricity.

Other Sylphon regulators, designed and produced by skilled specialists, are available to control pressures, and the temperature of air and gases. Costs are low, maintenance is rarely required.

For all the interesting details, write for your copy of Bulletin CS-20 today.



FULTON SYLPHON

Temperature Controls • Bellows • Bellows Assemblies

THE FULTON SYLPHON COMPANY • KNOXVILLE 4, TENNESSEE

Canadian Representatives, Darling Brothers, Montreal

BULLDOG LO-X *Ventilated* BUS DUCT

INCREASES POWER . . . DECREASES VOLTAGE DROP

Pioneer in the field of Plug-in Bus Duct for Branch Circuits, BullDog also leads with a Low Reactance (LO-X) *Feeder Type* Bus Duct in which exceptional design assures outstanding performance.

Using a unique method of arranging bus bars, termed "paired phasing" and mounted in an open mesh casing of expanded metal, BullDog Ventilated LO-X Feeder Duct transmits current with less reactance, lower voltage drop and reduced operating temperatures.

Available in ratings from 600 Amperes to 4000 Amperes, 600 Volts or less, it is the most efficient and economical distribution system now available for Feeder and Welder Circuits.

There is a BullDog field engineer in your vicinity ready to serve you—or if you prefer, write us direct for descriptive Bulletins.

BUY VICTORY BONDS

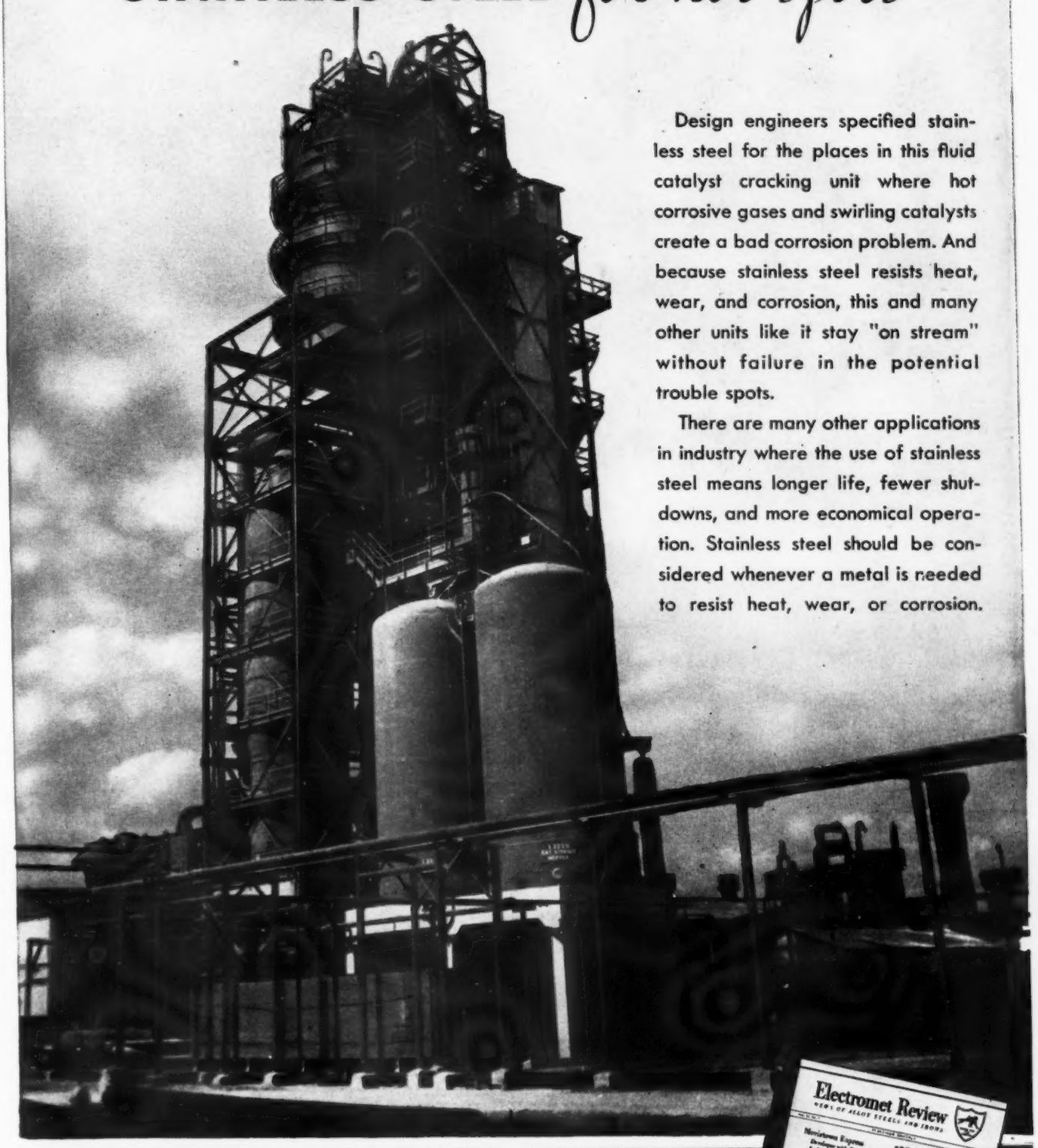
SALVAGE PAPER

DETROIT 32, MICHIGAN.
In Canada:
BullDog Electric Products of
Canada, Ltd., Toronto.
Field Offices in All Principal Cities.

BULLDOG
ELECTRIC PRODUCTS COMPANY

Also Manufacturers of
Vacu-Break Safety Switches—SafToFuse Panelboards—Switchboards—Circuit Master Breakers—Universal Trol-E-Duct for flexible lighting—BUStribution Duct for "Plug-in" power—Industrial Trol-E-Duct for movable "loads."

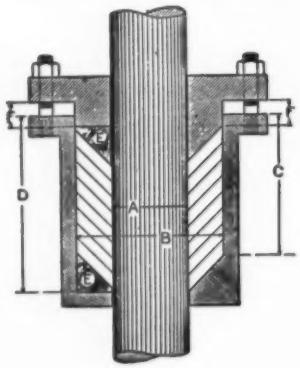
STAINLESS STEEL *for hot spots*



Design engineers specified stainless steel for the places in this fluid catalyst cracking unit where hot corrosive gases and swirling catalysts create a bad corrosion problem. And because stainless steel resists heat, wear, and corrosion, this and many other units like it stay "on stream" without failure in the potential trouble spots.

There are many other applications in industry where the use of stainless steel means longer life, fewer shutdowns, and more economical operation. Stainless steel should be considered whenever a metal is needed to resist heat, wear, or corrosion.

Other uses of stainless steel are described in ELECTROMET REVIEW, published by ELECTRO METALLURGICAL COMPANY, a Unit of UNION CARBIDE AND CARBON CORPORATION. ELECTROMET does not make steel, but produces the ferro-alloys used in its manufacture. If you need this complimentary publication, write to ELECTRO METALLURGICAL COMPANY, 30 East 42nd Street, New York 17, N. Y.



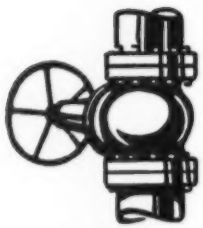
Q-P Self-Setting PACKING — PERFORMANCE-PROVED UNDER UNUSUAL OPERATING CONDITIONS . . . . . .

Q-P Self-Setting Packing has demonstrated its superiority under the most difficult conditions on land and sea and can be depended on to meet post war requirements for high maintenance economy. It is the ideal packing for superheated steam, saturated steam, hot and cold water, ammonia, fuel oil, compressed air, gases and acids and other operating conditions.

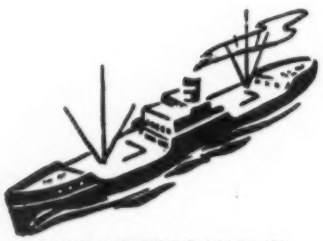
Q-P Self-Setting Packing is moulded to the exact diameter of the rod and stuffing box from various materials depending on the conditions involved. The smaller diameter of the ring or cone, always points toward the condition being sealed. Under pressure the lips of the packing are closed automatically against the rod and the side of the stuffing box with minimum friction, assuring a perfect seal without causing excessive friction or undue wear of rod or packing. Removal of pressure frees the packing from the rod.

Q-P Self-Setting Packing is made in solid and split types to specified rod and stuffing box dimensions. Its proper installation assures longer packing life, infrequent tightening up of gland, and elimination of rod scoring. Outstanding savings in maintenance are a matter of record wherever *Q-P Self-Setting Packings* have been used.

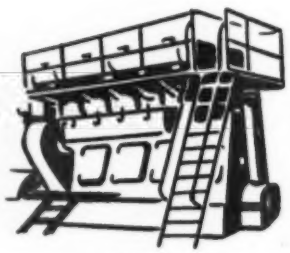
WRITE TO US AND OUTLINE THE SERVICE TO BE PACKED AND WE WILL SUPPLY THE PROPER PACKING



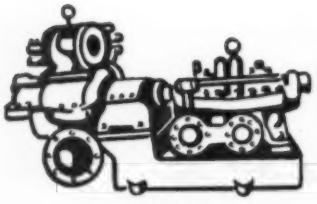
VALVES



TELEMOTORS-VALVE

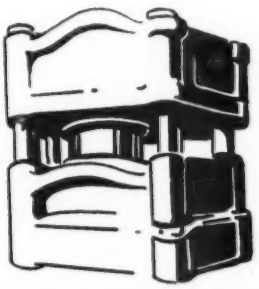


DIESELS

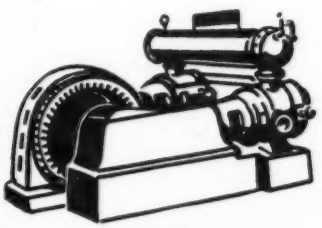


TURBINES

EXPANSION JOINTS



HYDRAULIC EQUIPMENT



COMPRESSOR (AMMONIA)

Sales Representatives

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Chapman Industrial Supply Co., Los Angeles 13, Calif.
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NEEDHAM HEIGHTS, MASS.

Uniform, High Quality Boiler Feed and Process Water...

REGARDLESS OF VARIATIONS IN SUPPLY

with

Amberlite Ion Exchange Resins

Variations in the quality of the water supply are no problem with the Amberlites. These efficient synthetic resin exchangers insure complete removal of objectionable salts, without close supervision or technical control during the treating process.

Whether softening or complete deionization (i. e. to give water comparable to distilled in quality) is needed, the Amberlites offer a low cost, simple method for the conditioning of both large and small volumes of water. A combination of high capacity and constant rate of exchange means greater throughput, smaller installation space and lower operating costs.

If you have a problem involving the removal of calcium and magnesium salts, iron, copper or *all* ionizable salts from process waters, let our technical staff show you how Amberlite Ion Exchange resins can do the job economically and efficiently.

AMBERLITE *is a trade-mark, Reg. U. S. Pat. Off.*

The AMBERLITES offer these Outstanding Advantages

1. **Uniformity of treatment regardless of supply variations**
2. **Minimum supervision and control**
3. **Low cost installation and operation**
4. **Softening or complete deionization**
5. **Reduction in akalinity and solids**
6. **High capacity plus high rate of exchange**

THE RESINOUS PRODUCTS & CHEMICAL COMPANY

WASHINGTON SQUARE, PHILADELPHIA 5, PA.

HERE'S ONE OF THE MOST EFFICIENT WAYS TO AIR CONDITION!

*Units can be also furnished for heating only, or cooling only — very flexible equipment. Every Multitherm is factory tested for performance.

MULTITHERMS—WHOLE "WORKS" IN ONE ASSEMBLY . . . BUILT FOR ALL SORTS OF INDUSTRIAL AND COMMERCIAL APPLICATIONS

The Clarage Multitherm unit shown above is a complete conditioning plant* . . . (1) it *cleans* the air, removing bacteria, pollen and dust . . . (2) it *cools and dehumidifies* in summer utilizing cold well water, brine or a direct expansion refrigerant . . . (3) it *heats and humidifies* in winter using steam or hot water . . . (4) it supplies at all times a circulation of conditioned air under positive fan pressure.

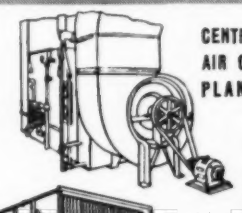
Multitherms are as easy and inexpensive to install as unit heaters — and just as satisfactory in operation. They may be suspended from the ceiling, mounted on platforms, or installed on the floor. Sizes range from 400 to 13,600 c.f.m. If the job is extra large, it can be handled with two or more units.

Look into Clarage Multitherms if you have any type of air conditioning problem. They are engineered to give precision results — compact to save space — of heavy duty construction for years of continuous trouble-free service. *And, as compared to central station conditioning, you can usually save considerable money.*

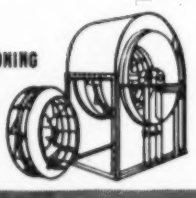
Write us, outlining your requirements — or ask for Bulletin 107 giving complete information.

SOME OF QUR OTHER PRODUCTS

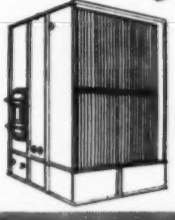
UNIT HEATERS



CENTRAL STATION AIR CONDITIONING PLANTS



AIR CONDITIONING AND VENTILATING FANS



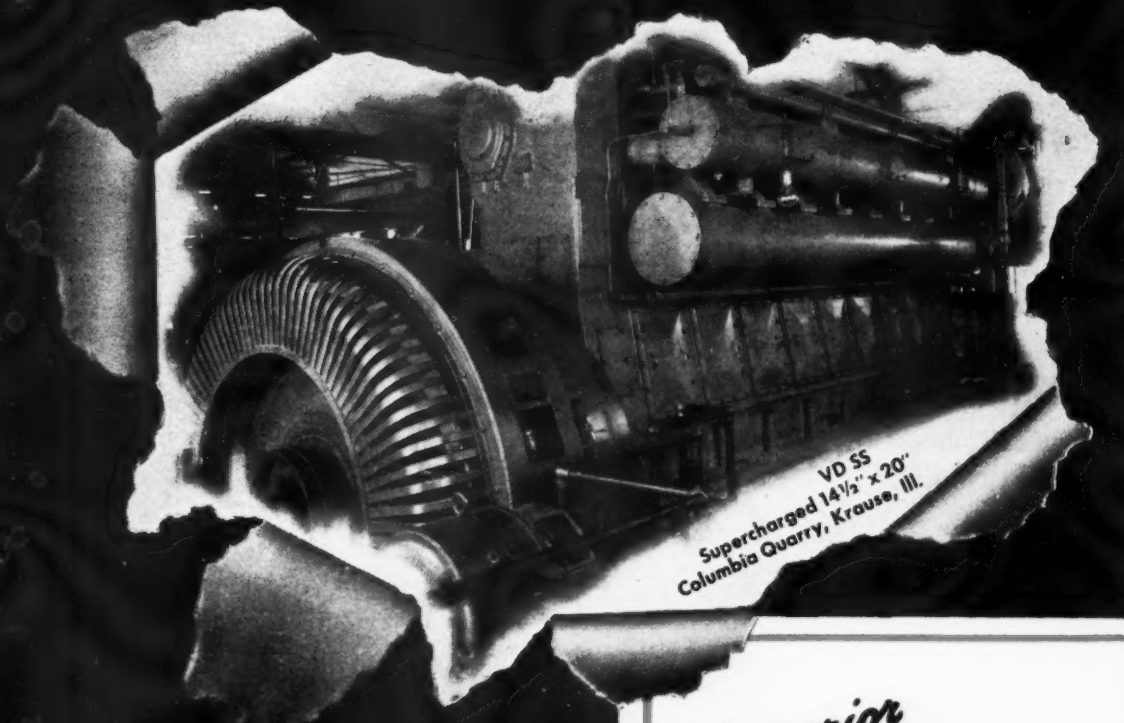
AIR WASHERS

CLARAGE
FAN COMPANY
Kalamazoo, Michigan

APPLICATION ENGINEERING OFFICES IN ALL PRINCIPAL CITIES

Superior DIESEL

a fine reputation for economical power . . . . .



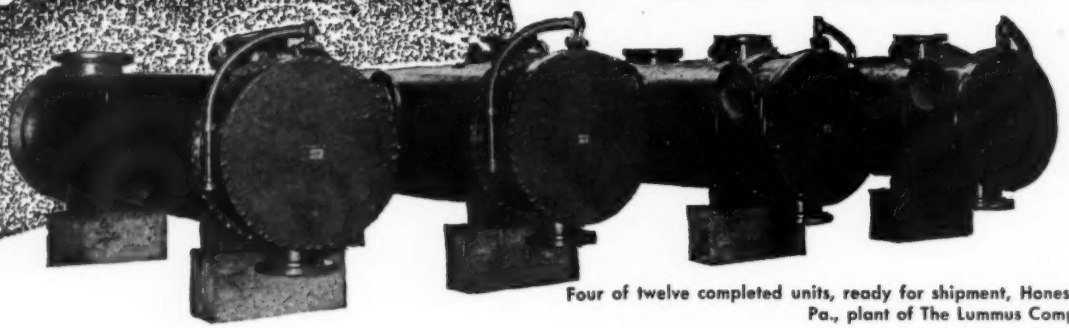
SUPERIOR DIESELS • STATIONARY, 28 to 1325 H. P.
MARINE, 28 to 1325 H. P. • GENERATOR SETS, 20 to 930 kw.

Superior **ENGINES**
Division of
THE NATIONAL SUPPLY CO.
Plant and General Sales Office:
Springfield, Ohio

Accurate alignment during assembly facilitates removal of tube bundles from shells.

A Major Refiner *selects* LUMMUS PROCESS CONDENSERS

ON PERFORMANCE RECORD OF *54 units*



Four of twelve completed units, ready for shipment, Honesdale, Pa., plant of The Lummus Company.

● Because of the outstanding performance at maximum loads of 54 Lummus Process Condensers having a total surface of 178,740 sq. ft. — operating for the past two years in two of the world's largest Butadiene plants — a major refiner recently ordered 12 identical units for installation in a new plant. These installations were originally designed to meet a very special condensate temperature condition and only the long, varied experience and knowledge of performance gained in operation of other units justified their adoption in these vital war plants without extensive experimentation.

Simplicity of design is the key note of the plus performance and trouble free operation of this and all other Heat Exchangers designed and fabricated by Lummus Co.

Lummus engineering service includes the study of specific Heat Exchanger problems and equipment designed to meet your individual conditions.

For complete information write to: The Lummus Company, 420 Lexington Ave., New York 17, N. Y.

LUMMUS

HEAT EXCHANGERS

Eliminate DAMAGING WATER and OIL from Your Compressed Air Lines

WITH

ADAMS AFTERCOOLERS and CYCLONE SEPARATORS

Air Cooled to Within 10 DEGREES of Cooling Water! EASILY INSTALLED! Pipeline Construction

● ADAMS equipment insures a constant supply of cool, moisture-free, oil-free air to power your compressed air tools with the highest efficiency and safety . . . at the *lowest* installation and maintenance cost.

ADAMS AFTERCOOLERS are *guaranteed* to cool air to *within 10 degrees* of your cooling water. This means *extra* thoroughness in condensing water and oil vapors from your compressed air.

NO FOUNDATION or other facilities are required for installation. The Adams "pipeline" construction permits the After-cooler and Cyclone Separator to fit right into a section of the pipe line . . . either vertically or horizontally!

CYCLONIC SEPARATION is the Adams principle . . . engineers agree that it is *far more efficient* than other mechanical separation!

WRITE!

today for full engineering data on improved pneumatic power performance. Ask for Bulletin 703.

R. P. ADAMS CO., INC.

67 Chicago St., Buffalo, N. Y.

ADAMS AFTERCOOLERS and CYCLONE SEPARATORS

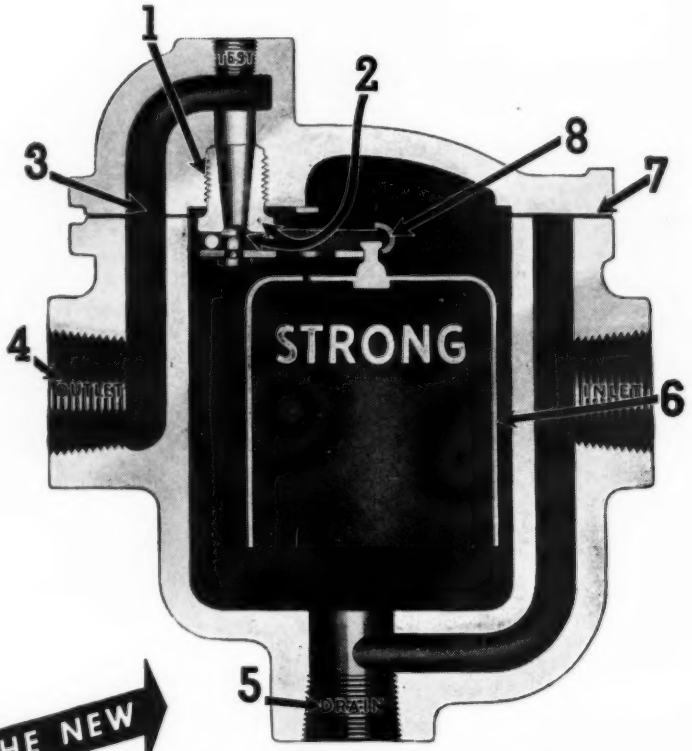
Eight Improvements

GENUINE STRONG make STRONG 70 Series Traps Better than Ever!

Look at these new features:

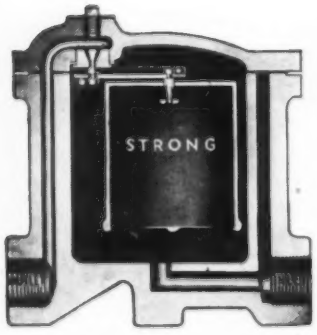
1. Renewable seat replacing pressed-in design;
2. Anum-Metl* valve and seat with new scientifically designed Hi-Cap* (patent applied for) orifice . . . up to 25% greater capacity;
3. Oversize inlet and outlet ports—increased flow capacity;
4. Relocated inlet and outlet connections—avoids backflow on light loads;
5. Drain connection added—available for bottom inlet;
6. One-piece, deep-drawn, stainless bucket—no welds;
7. Larger gasket area—means positive seal;
8. New, improved, stainless, high-ratio leverage.

Plus Adaptability to older models with change-over assembly including Hi-Cap orifice.



New 70 Series Strong Trap, No. 170

COMPARE THE NEW WITH THE OLD



Old 70 Series Strong Trap

In improving the 70 Series trap, Strong has remembered the thousands of older style 70 Series traps still in service after many years. Each improvement bears the "proof in service" label, so Strong quality remains uniformly high. Service continues to be available on all Strong traps, and they can be completely modernized to include the improvements listed above.

With a complete line of Strong open and inverted bucket traps at their disposal, Strong engineers can specify exactly the right type of trap for your particular application. For full details, write for the new Strong Catalog No. 67.

STRONG, CARLISLE & HAMMOND COMPANY, Cleveland 13, Ohio

*Registered Trade Mark

REG. TRADE MARK

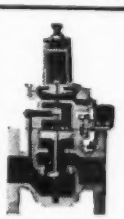
OTHER ANUM-METL Reg. Trade Mark

STRONG

STEAM SPECIALTIES

Strainer

No. 80 Series Trap



Reducing Valve

Modern POWER INSTALLATIONS

through use of PIPE BENDS

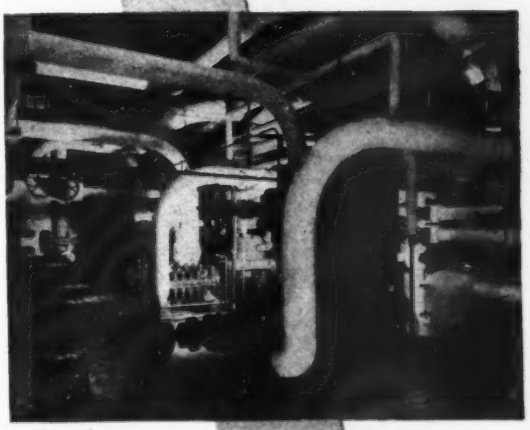
HAVE PIPING TAILORED TO FIT SPECIFIC CONDITIONS

Miscellaneous Pipe Bends

PIPE bends can be made to any desired length and a number of bends can be made into a single length of pipe so as to produce a tailor-made pipe connection that will fit exactly into the space available.

The result is a neater, more compact, highly efficient, and economically operated system.

Our engineering department will be glad to show you how and where this type of fabrication can be used to advantage. Contact our nearest representative or write us direct. There is no obligation.



Pipe Bends in Completed Systems

Double Off-set "U" Expansion Bend

Double 90° Pipe Bend

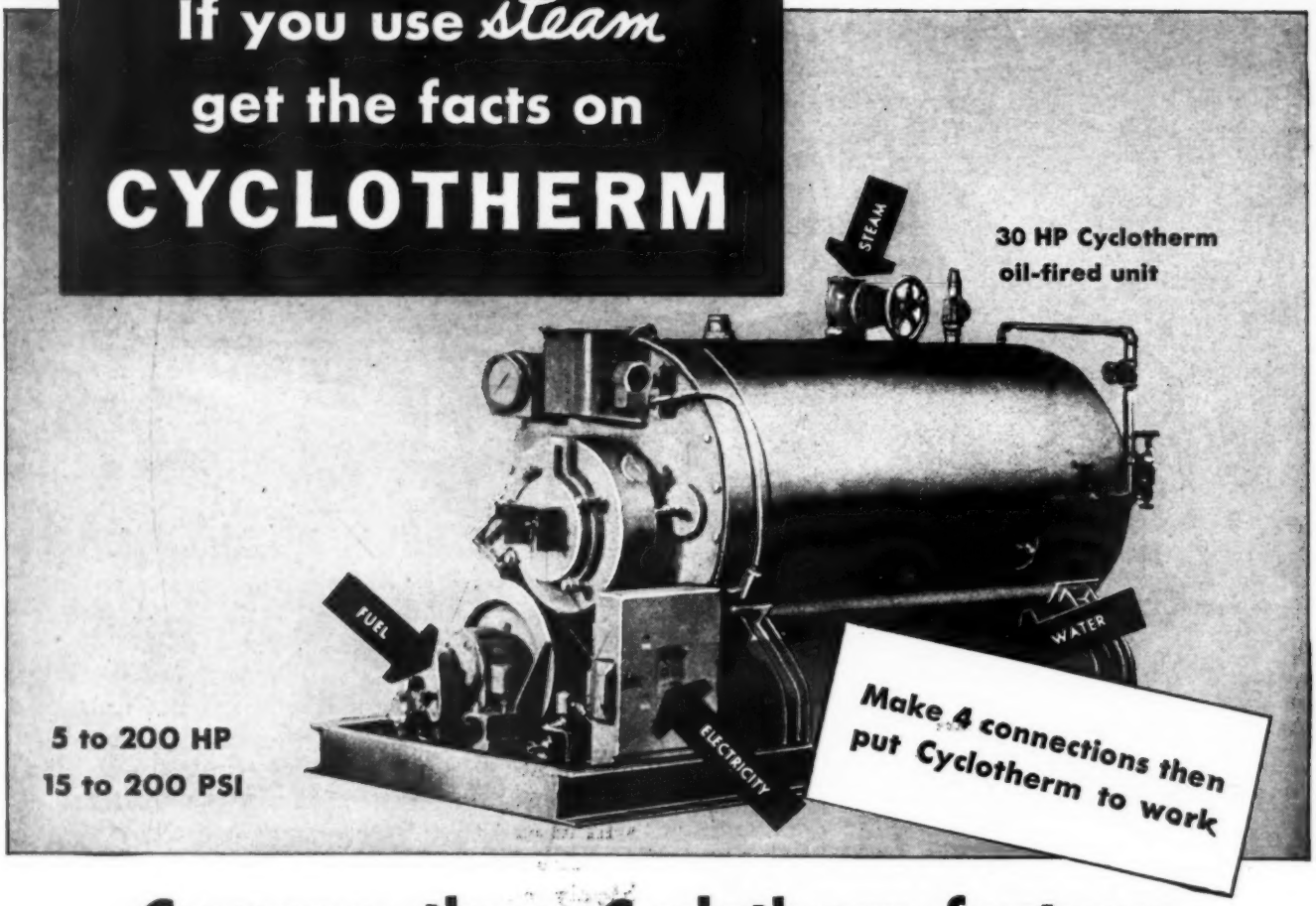
Pittsburgh Piping AND EQUIPMENT COMPANY

10 Forty-Third Street—Pittsburgh, Penna.

Woolworth Building, New York
Chamber of Commerce Bldg., Indianapolis
Book Tower, Detroit
525 Market Street, San Francisco
634 S. Gramercy Place, Los Angeles
Peoples Gas Building, Chicago
Public Square Building, Cleveland
10 High Street, Boston
Heights State Bank Bldg., Houston
Whitehead Building, Atlanta

BUY VICTORY BONDS

If you use *steam* get the facts on CYCLOTHERM



Compare these Cyclotherm features with those of any other make

• *Cyclotherm Burner*—Specially designed, "built-in", integral component of steam generator unit—Provides complete combustion with rapid, evenly distributed heat transfer—Fires any liquid or gaseous fuel.

• *Fully Automatic Heavy Oil Operation*—Cyclotherm units 80 to 200 HP.

• *Wide Range Modulation*—Firing rate modulates automatically from 30% to 100% of full load in response to steam demand, sizes 80 to 200 HP.—Oil or gas operation.

• *Gas Firing*—Cyclotherm units may be fired with Manufactured, Mixed, or Natural Gas. Completely automatic operation for all sizes.

• *Cyclotherm Combination Burner*—Fires oil or gas; change-over from one fuel to another by merely throwing a switch.

• *Maximum Operating Efficiency*—Operating efficiency of Cyclotherm Generator unit will be not less than 80%.

• *Single Responsibility*—One manufacturer to deal with. Cyclotherm units shipped complete with boiler, burner, all controls and accessories assembled, fully piped and wired, test fired for performance, ready to operate on arrival.

• *Performance Record*—Thousands of Cyclotherm units performed all over the world with our armed services. Their record of efficient duty is your guarantee of the engineering "know-how" and experience built into each unit.

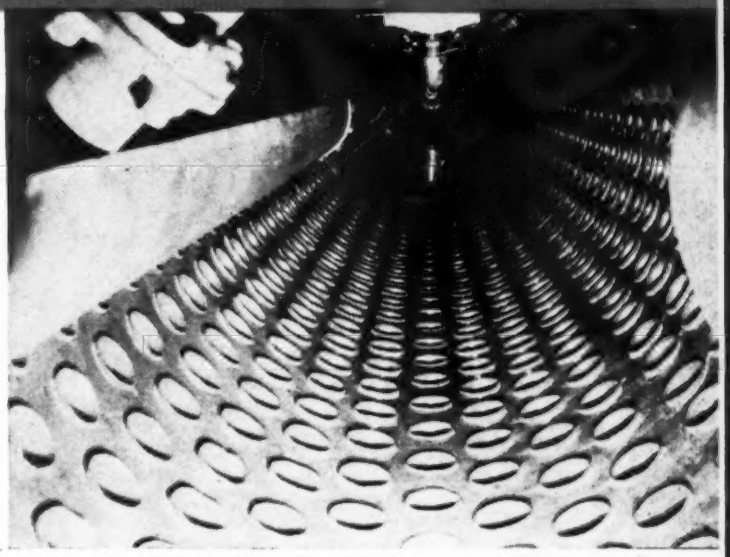
• *Fits in Small Area*—More compact and space saving—Favorable "go thru" dimensions.

Write, wire or phone for more complete information.

CYCLOTHERM STEAM GENERATORS

CYCLOTHERM CORPORATION, 90 BROAD STREET, BOX 402, NEW YORK 4, N. Y.

DOWELL



full power restored

When the load is heavy and your heat-exchange equipment *must* function at full capacity—that's when Dowell's chemical method of cleaning unwanted scale and sludge from boilers *is most appreciated!*

Power plant engineers looking for a safe, rapid, thorough means of restoring designed operating efficiency are turning more and more to Dowell.

Dowell specialists offer a complete service. They pre-inspect the equipment to be cleaned. They chemically analyze samples of deposits found in *your* plant. And after this careful preparation, they bring with them the proper chemicals and adequate equipment to control completely every stage of the treatment—to insure effective removal of the insulating deposits.

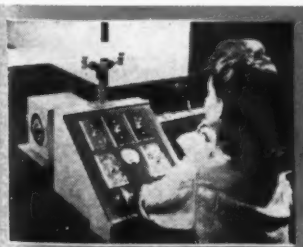
For complete details, call the nearest Dowell office for a free estimate. Ask for your copy of "More Power to America's Industry"—new color booklet which explains and illustrates Dowell's thorough chemical cleaning service.

DOWELL INCORPORATED • TULSA 3, OKLAHOMA

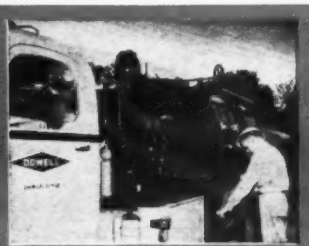
Subsidiary of The Dow Chemical Company

New York • Philadelphia • Baltimore • Buffalo • Cincinnati • Cleveland
Chicago • Detroit • St. Louis • Houston • Kansas City • Wichita
Mt. Pleasant, Michigan • Salem, Illinois
Long Beach, Casper: Dowell Affiliate—International Cementers, Inc.

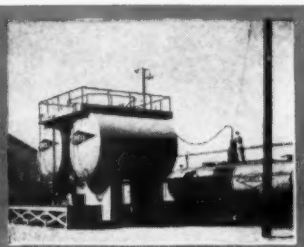
SPECIALISTS IN CHEMICAL CLEANING SERVICE



Dowell's experienced industrial engineers are backed by the complete research and technical facilities of The Dow Chemical Company.



Dowell's equipment is modern and complete—scientifically designed. Treating stations and chemical warehouses conveniently located.

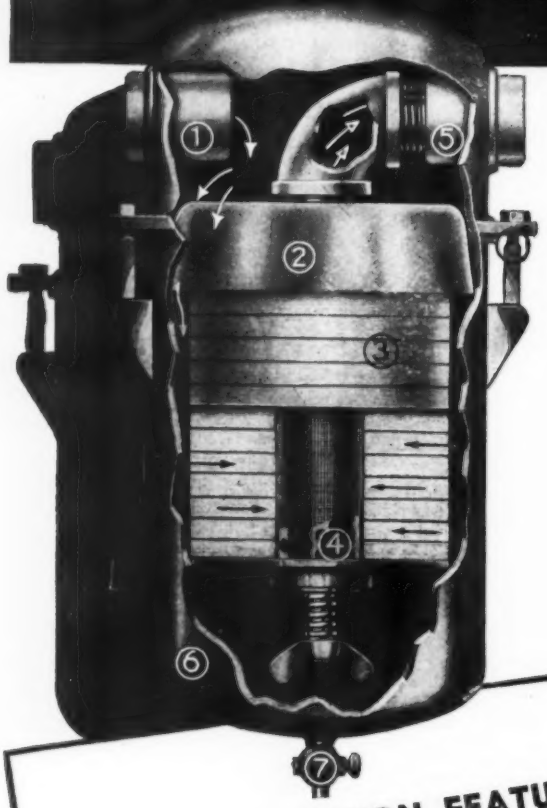


Dowell cleaning solvents are "tailor-made" to fit each job. All ingredients are of the highest quality, chosen for best results in your plant.

DOWELL

FOR INDUSTRIAL CHEMICAL SERVICE

HAZARD of Oil and Moisture in Automatic Controls NOW ELIMINATED



New Filter Delivers Dry Air Only

Amazing results are being reported by users of the Model AAPHS Pipe Line Filter as a final stage in the protection of delicate pneumatic control instruments.

Typical comment is that of a large producer of electric and steam power who says, "We tried several well-known methods of moisture and oil elimination without satisfactory results. Your Model AAPHS was finally installed in the air line and since then we have had no trouble whatever with oil or moisture in our automatic controls."

NEW 44-PAGE CATALOG: Describes entire line, including filters for building ventilation, pipe lines, engine, and compressor intakes. Your copy is ready.

DOLLINGER CORPORATION
23 CENTRE PARK, ROCHESTER 3, N. Y.

"Air Filter Headquarters"

STAYNEW PROTECTOMOTOR FILTERS

CONSTRUCTION FEATURES

(1) inlet; (2) baffle that distributes vapor-laden air to sides of container (6); (3) felt rings; (4) perforated liner; (5) outlet; (7) drain cock; (8) swing bolts for easy inspection (optional).

THICK FELT RINGS that remove every trace of oil or moisture.

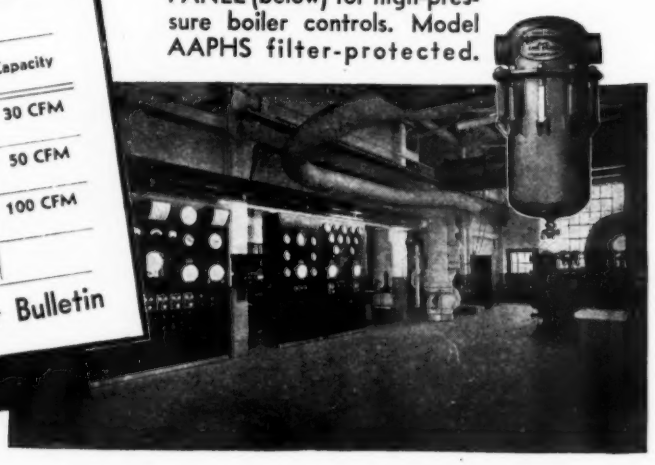
SPECIFICATIONS

Model	Standard Pipe Size	Capacity
AAPH-02 AAPHS-02	¼"	5 CFM
AAPH-01 AAPHS-01	¼"	7 CFM
AAPH-0 AAPHS-0	½"	10 CFM
AAPH-1 AAPHS-1	¾"	20 CFM
AAPH-2 AAPHS-2	1	30 CFM
AAPH-4 AAPHS-4	1½"	50 CFM
AAPH-5 AAPHS-5	2"	100 CFM

Letter S in code numbers indicates swingbolt type which facilitates inspection.

Write for Bulletin

PANEL (below) for high-pressure boiler controls. Model AAPHS filter-protected.



NEAR OR FAR

YOU CAN COUNT ON YOUR INDUSTRIAL SUPPLY SPECIALIST

WHETHER you are located right in town or miles from nowhere, your Industrial Supply Specialist will provide you with exactly the equipment and supplies you need to operate at peak production and efficiency. To carry maximum tonnage at lowest cost, consult your Industrial Supply Specialist regarding the conveyor belt best suited to your specific materials handling requirements. He will recommend Monarch or Ajax for severe operating conditions, and Conservo for intermittent or light service. All three Hewitt brands are Job-Engineered to insure maximum efficiency and lowest cost for your conveyor operation.

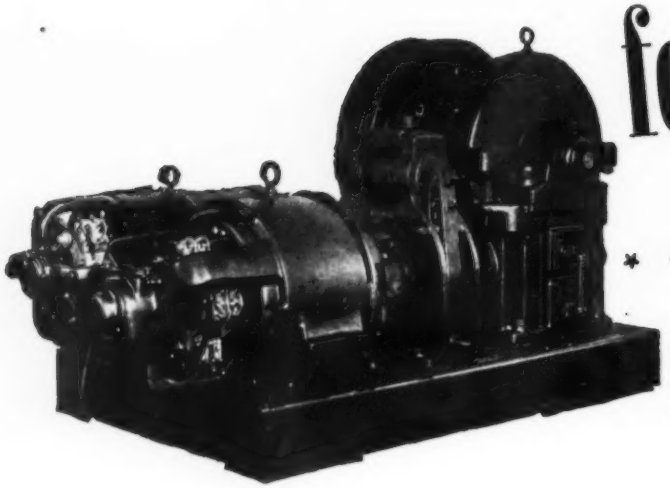
•

Specify "Hewitt" for quality industrial rubber products. Phone the Hewitt distributor listed in the Classified Section of your telephone directory . . . or write to Hewitt Rubber Corporation, 240 Kensington Avenue, Buffalo 5, N. Y.

Quality Rubber Products for Industry for 86 Years

HEWITT RUBBER
of Buffalo
Job-Engineered Industrial Hose • Belts • Molded Goods

Otis Maintenance for Otis Elevators



Otis Maintenance is a service under which the owners of Otis elevators place the entire care of their elevator equipment in the hands of the manufacturer.

This service by Otis for Otis elevators cannot be duplicated at any price. There are three reasons for this:

Men — a field and headquarters organization combining the knowledge and experience of trained elevator men with that of those who designed and built the equipment.

Materials — including genuine Otis parts, special Otis tools, and over a million dollars worth of emergency replacement equipment.

Maintenance Methods — the result of periodic inspections, lubrication, adjustment and replacement of parts, supported by scientific study and research to make elevators run better and last longer . . . a clinic that, *in one day*, gains experience that would take the average owner over fifty years to accumulate.

Under Otis Maintenance the world's greatest store of elevator knowledge and experience is combined with the facilities of the manufacturer of more than half of the world's elevator equipment.

You can obtain this service for your elevators at a flat monthly rate. Complete details are available through local Otis Elevator Company offices.

Otis ELEVATOR COMPANY
OFFICES IN ALL PRINCIPAL CITIES

REMOVE DIRT....YES! BUT REMOVE THE WATER TOO!

IT is only doing half a job to remove dirt from turbine oil. If ***full*** protection is to be given a power unit, the oil must be dehydrated as well. For water, more than any other single factor, contributes to the formation of sludge—the real trouble-maker in turbine oil lubrication.

That is why a De Laval Oil Purifier is the most effective turbine oil maintenance unit available. Dirt and water are thrown out of the oil by centrifugal force, the water being continuously discharged, the dirt collecting in the bowl outside of the zone of purification. The efficiency of purification is as high at the ***end*** of a run as at the ***beginning***.

Some power plants call for a single De Laval Oil Purifier, some a complete De Laval-Funk Process, which minimizes the formation of sludge within the turbine lubricating system while it also continuously purifies the oil by means of the De Laval Oil Purifier—the ultimate in turbine oil protection. Whichever ***your*** plant requires, there is a wide range of capacities available to enable the selection of the correct unit.

• Write for Bulletin No. 400.

DE LAVAL

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 19
THE DE LAVAL COMPANY, Limited
MONTREAL PETERBOROUGH WINNIPEG VANCOUVER

LUBRICATING OIL PURIFIERS

Symbol of the Modern Way

TO REMOVE WATER-DEPOSITED SCALES AND SLUDGES FROM ALL TYPES OF INDUSTRIAL EQUIPMENT

INTERNATIONAL CHEMICAL SERVICE has proved amazingly successful for removing water-deposited scale and sludge from boilers, economizers, condensers, feed water heaters, cooling jackets, water lines, and other similar installations. The chemical solvents penetrate wherever water can flow, so that all interior surfaces are thoroughly cleaned, including small tubes, curved areas and turns, which are difficult, if not impossible to clean by mechanical means.

Heat transfer units are quickly restored to original efficiency—no dismantling or disassembly is necessary—and time off the line is reduced to a matter of hours.

ANALYSIS DETERMINES SOLVENT

Determination of the proper chemical solvent is based upon a comprehensive analysis of the scale to reveal its exact composition. This requires tests of the chemical solubility of the scale, as well as X-Ray examination if any complex substances are present.

PROMPT, DEPENDABLE SERVICE

INTERNATIONAL Equipment, manned by highly skilled technicians, is available at any pre-determined hour to meet your convenience. All trucks, tanks, pumps, and similar equipment are furnished. It is not necessary to dismantle or disturb the installation. Within a few hours scale is removed, the system drained, flushed and neutralized, and operations resumed.

A WORD ABOUT INTERNATIONAL CEMENTERS

Founded several years ago by Byron Jackson Co., Dowell, Incorporated, and Baker Oil Tools, Inc., INTERNATIONAL CEMENTERS, INC. originally was engaged in the cementing and acidizing of oil and gas wells. Following development by The Dow Chemical Company of processes for chemical cleaning of industrial heat exchange equipment, INTERNATIONAL CEMENTERS, INC. was licensed to perform these operations in the Western States through its CHEMICAL SERVICE DEPARTMENT.

CONSULTATION AND ANALYSIS

Consultation, scale analysis, recommendations for its removal, and a definite estimate of cost of service are available without obligation to operators of medium size or large installations of industrial equipment.

CHEMICAL SERVICE DEPARTMENT

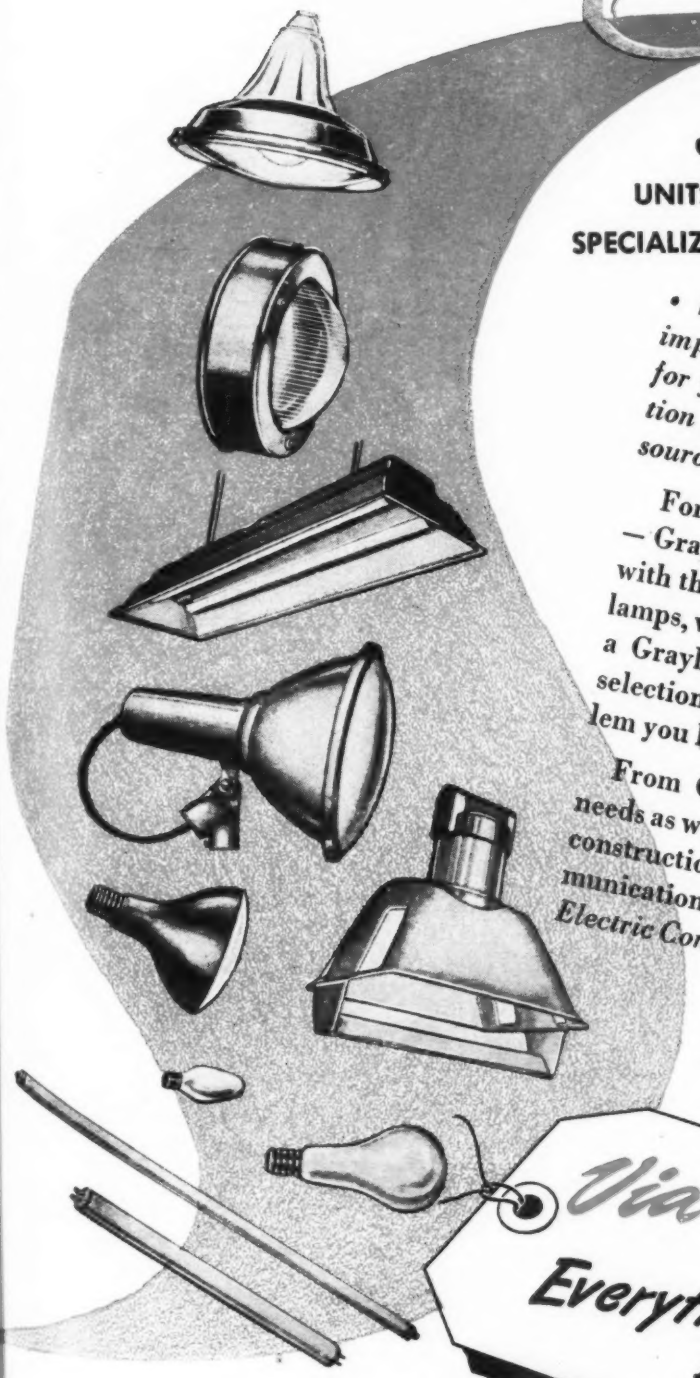
INTERNATIONAL CEMENTERS Inc

3605 Long Beach Blvd., Long Beach 5, California • Telephones: Los Angeles NEvada 62493—Long Beach 485-91 • Bakersfield, California—Telephone 30255 • Oakland, California—1629 Telegraph Ave. (Zone 12)—Telephone GLencourt 5838 • Casper, Wyoming—Telephone 972.

Licensed under processes practiced by DOWELL, INCORPORATED, a subsidiary of THE DOW CHEMICAL CO.

Light

for your plant or product



GRAYBAR OFFERS WIDEST SELECTION OF LIGHTING UNITS AND LAMPS . . . NEWEST TYPES . . . SPECIALIZED SERVICE . . . FASTER DELIVERY!

• *Whatever your lighting requirements, Graybar can impartially recommend the exact lighting equipment for your particular needs from the most complete selection of lamps and lighting units available from any one source.*

For general or local illumination — indoors or outdoors — Graybar can provide you or your electrical contractor with the latest, most suitable lighting units, matching G-E lamps, wiring, transformers, and ballasts. Near you there's a Graybar Lighting Specialist who can facilitate their selection and application to solve any illumination problem you have.

From Graybar you can get all your other electrical needs as well — wiring supplies, power apparatus, outside-construction materials, ventilating equipment, tools, communication units. Call our nearest office or write *Graybar Electric Company, Graybar Building, New York 17, N. Y.*

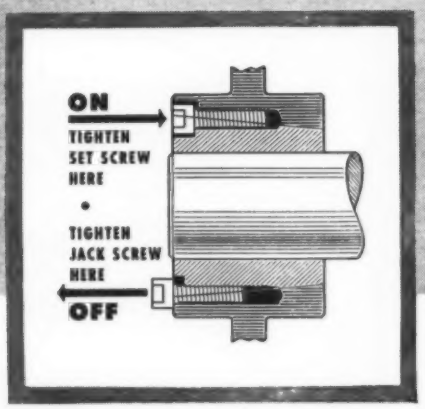
4602

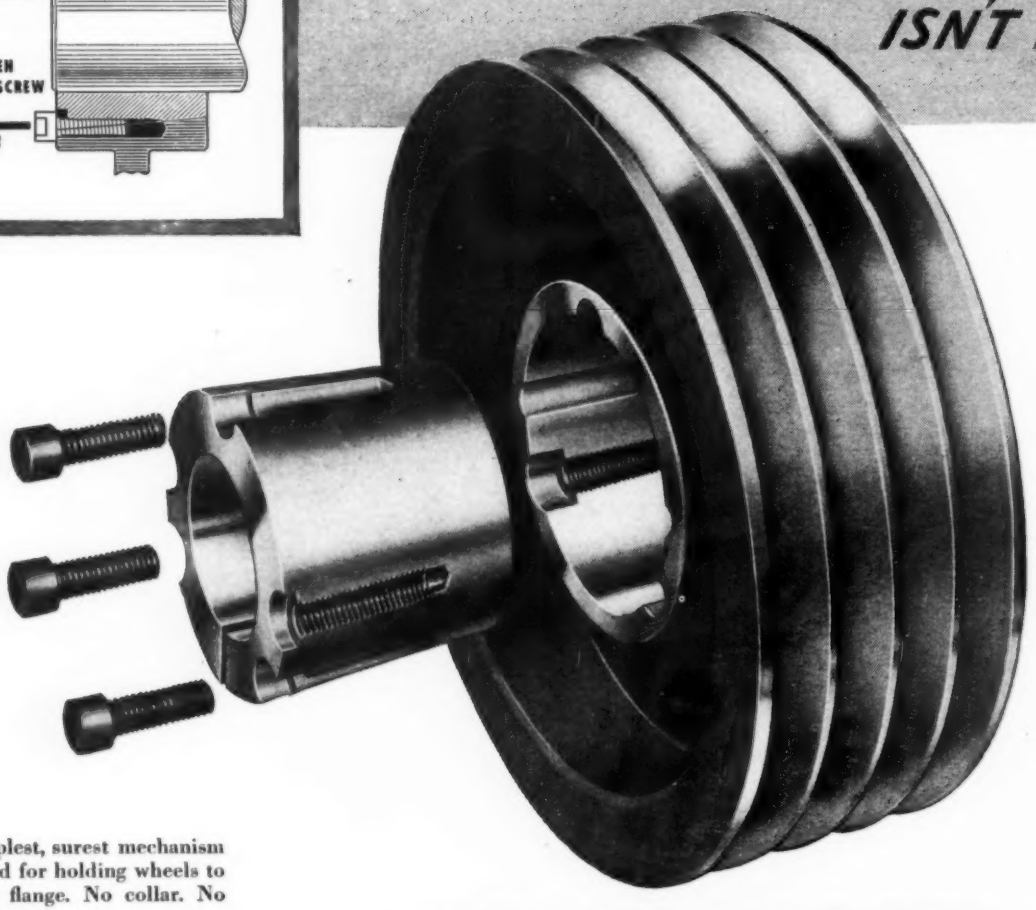
IN OVER 90 PRINCIPAL CITIES

Via Graybar

Everything Electrical

Simple, ISN'T IT?





- The simplest, surest mechanism ever devised for holding wheels to shafts! No flange. No collar. No protruding parts.
- The Taperlock Sheave mounts as a complete unit. Slip it on, line it up and tighten *while sighting.* It's in place on the first try!
- The bushing is wedged into the sheave by means of set screws—with a firmness equivalent to a shrunk-on fit—whether the shaft is standard or normally undersize.
- The Taperlock runs *true.* The bushing extends the entire length of the hub; it provides a *full* bearing surface.
- Close mountings are made possible. No flange nor collar nor other device is required at either end of the sheave hub.
- The Taperlock "unlocks" with less effort than any other sheave—due to its special taper.
- Taperlock Sheaves will be stocked by Dodge Transmissioneers in principal cities—and will be available in ALL stock sizes.

New TAPER-LOCK *Sheave*

PATENT APPLIED FOR

Easy on—easy off—locks fast to the shaft! ALL the advantages you've ever dreamed about in a sheave are *here*—in the simplest, quickest acting mechanism ever developed for the purpose!

For full details call your local Dodge Transmissioneer. You'll find his name listed under "Power Transmission Equipment" in your classified telephone directory. Or write

DODGE MANUFACTURING CORPORATION, MISHAWAKA, INDIANA

DODGE
MISHAWAKA

SIGN OF THE DODGE TRANSMISSIONEER
There are 257 Dodge factory graduate Transmissioneers, located in principal cities, to show you NEW and BETTER ways of transmitting power. See your local classified telephone directory.

Sealing Materials are Changing

See actual samples of Newly-Processed Familiar Materials, and Better-than-natural Synthetics! *Get Free Folio!*

Now, time-honored gasket and sealing problems find new answers . . . and so do new sealing problems in new products and new designs . . . for here at Fel-Pro, radical changes and improvements are taking place in gasketing, sealing and dampening materials. And Fel-Pro's TWO ADVANTAGES (technical know-how, and on-time delivery of quality products in wanted volume) are back of every one of these Fel-Pro pioneering moves.

Many current sealing questions are already answered by Fel-Pro's Thiokolized Felpak, Karropak, Fish-paper, Chipboard, Fibre, Cork and other modernly processed materials, or, by Fel-Pro synthetics that, for many applications, are actually better than natural products formerly used. Still other questions are being answered—perhaps yours among them—through Fel-Pro's no-charge consultation service.

GET NEW FREE SAMPLE BOOK

The whole story to date—in terms of working data and actual samples of successful materials—are in the new letter-size (8½" x 11") Fel-Pro filing folio . . . a complete modern reference on gasketing and sealing. Get your free copy and be abreast of gasket developments!

USE THIS COUPON

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Gentlemen: Without cost or obligation to me, please send me your sample folio of modern sealing materials.

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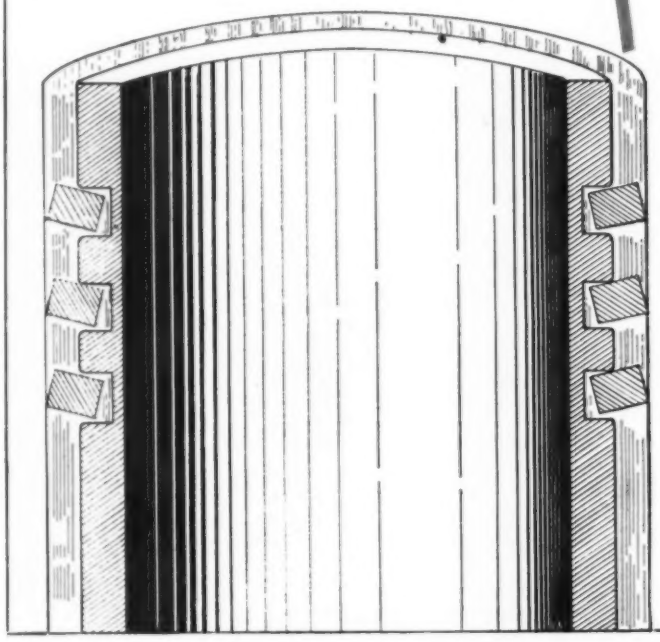
. . . *with* Sealing Materials, Gaskets, Packing, Washers, Sound and Vibration-Dampening Materials . . . Specially Treated, Die-cut and Fabricated by Fel-Pro.

Diesel Engine DANGER points



"ROCKING" PISTON RINGS SCORE LINERS

"Rocking" piston rings, the result of excessive wear in the ring grooves of Diesel engine pistons, are the source of considerable lay-off time and expense to Diesel operators—Wear-enlarged grooves permit rings to rock, and "bite" into cylinder walls. The result is usually a costly overhaul to replace not only pistons, but worn liners as well. It's a danger point in many Diesels—but "rocking" rings and their cause, enlarged ring grooves, can be minimized.

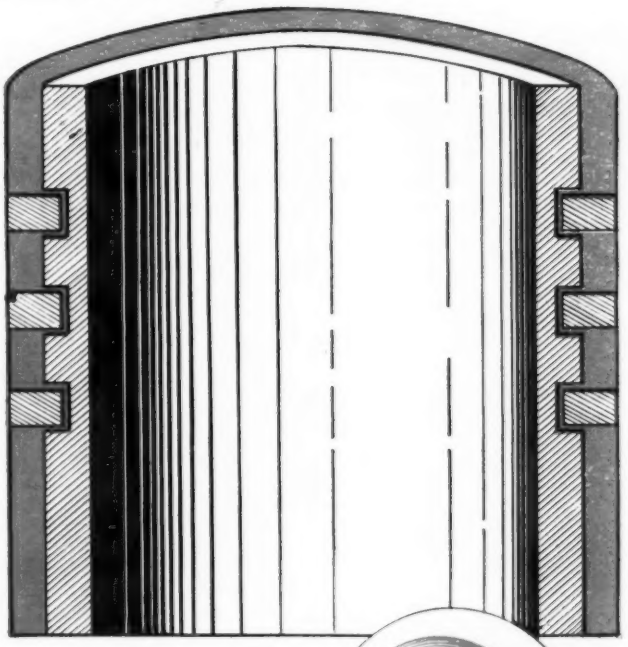
RPM DELO Oil clings to hot engine areas often left exposed to wear by ordinary uncompounded oils.

RING GROOVE WEAR REDUCED BY RPM DELO OIL

In a series of 1000-hour laboratory tests, Standard scientists proved that ring groove wear can be minimized with RPM DELO Diesel Engine Lubricating Oil.

Piston ring groove wear in an engine operated on a top quality straight mineral oil was thirty times that experienced with RPM DELO Oil in an identical test.

RPM DELO Oil reduces wear due to a metal-adhesion additive which makes it cling to and lubricate hot engine areas other oils often leave bare, and to other compounds which eliminate stuck rings and engine deposits, prevent bearing corrosion, stop oil foaming.



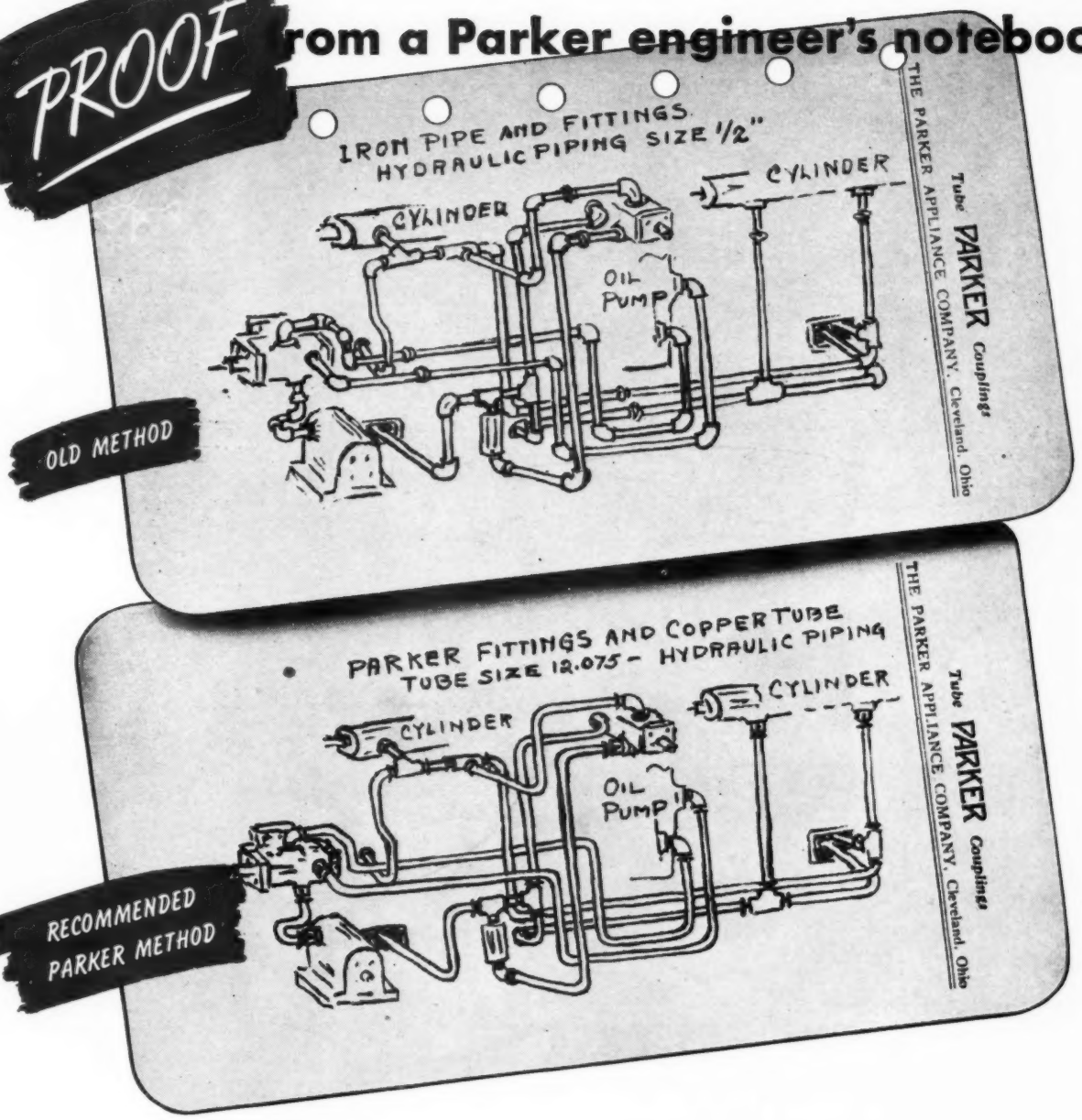
To match the fine performance of RPM DELO Oil use these equally efficient companion products from the same famous "RPM" line—

RPM HEAVY DUTY MOTOR OIL
RPM COMPOUNDED MOTOR OIL
RPM GEAR OILS & LUBRICANTS
RPM GREASES

For additional technical information write Dept. T-X, Standard of California, San Francisco 20, California, or California Commercial Company, 30 Rockefeller Plaza, New York 20, N.Y.

STANDARD OF CALIFORNIA

PROOF from a Parker engineer's notebook



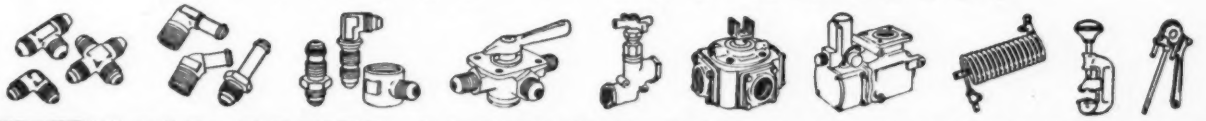
Advantages of Parker Recommendation

- Streamlined flow, free from obstructions. No sharp turns and pockets to cause turbulence. Less pressure drop; capacity and pressure requirements reduced.
- Fewer joints and connections—to reduce leakage, even under high pressure, vibration, shock, fluid hammer, surge or accidental abuse.
- Compact, spacesaving, neat and simplified installation, especially in tight places—yet all parts are accessible for quick, easy installation and service.

We've engineered Fluid Power installations for many people—to bring them these advantages, under a wide range of exacting conditions. May we do the same for you? Let's talk it over.

THE PARKER APPLIANCE CO.

CLEVELAND • LOS ANGELES

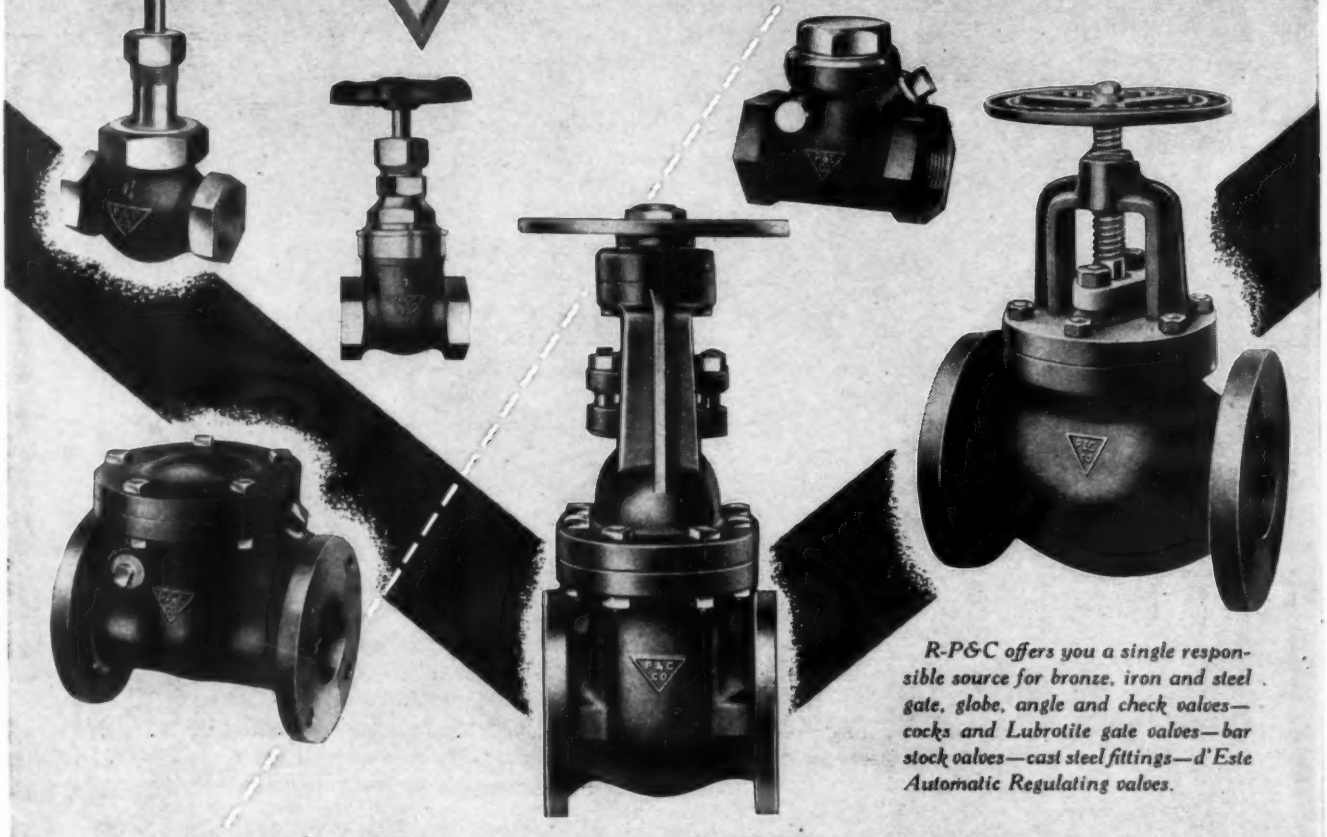


FLUID POWER PRODUCTS FOR ALL INDUSTRY

MORE AND BETTER *Service* FROM TODAY'S VALVES

"RESOLVED:
"That the superintendent
"shall be held responsible
"for the production of goods
"as near perfect in design,
"material and workmanship
"as shall make them merchantable
"and of a character that will serve
"to establish for this company
"a high reputation."

The policy expressed by this early Pratt & Cady Board of Directors Resolution has not been shaken even by the great World War. More than ever before the valves offered by Reading-Pratt & Cady today meet the demand for longer and better service.



R-P&C offers you a single responsible source for bronze, iron and steel gate, globe, angle and check valves—cocks and Lubrotite gate valves—bar stock valves—cast steel fittings—d'Este Automatic Regulating valves.

READING-PRATT & CADY

MANUFACTURERS OF
READING CAST STEEL VALVES AND FITTINGS • PRATT & CADY BRASS AND IRON VALVES
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ACCO TRADE MARK

DESIGN PREFABRICATION AND ERECTION OF POWER PIPING

Our ability to handle the largest as well as the smallest jobs in power piping design, plus Blaw-Knox prefabricating and erecting facilities, are described in the unique books entitled "Design of Piping for Flexibility with Flex-Anal Charts" and "Functional Spring Hangers and Vibration Eliminators".

These books reflect the background of power piping design, its specialized engineering knowledge and unique fabrication procedure. Copies will be sent free to engineers writing on their business letterheads.

BLAW-KNOX COMPANY
POWER PIPING DIVISION
1525 PENNSYLVANIA AVE. N. S., PITTSBURGH, PENNA.

How Sarco Serves in

2 LSI ELECTRIC CONTROLS
21 TEMPERATURE REGULATORS FOR PROCESSES
5 87C THERMOTON CONTROLS FOR PLATING
85 STRAINERS UP TO 3"
197 FLOAT-THERMOSTATIC STEAM TRAPS ¾ to 2"
7 SCRAPER STRAINERS 1¼ and 1½"
12 DIAL THERMOMETERS
274 BUCKET STEAM-TRAPS ½ to 1¼"
22 RADIATOR VALVES
27 SH 65 RADIATOR TRAPS

THE MODERN FACTORY

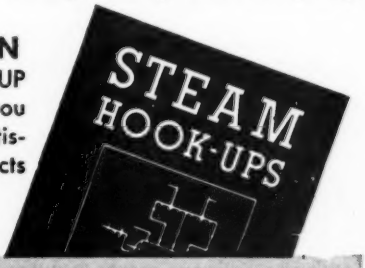
Here is a typical case with no name mentioned, because it is a defense plant. The industrial company and their contractor decided to standardize on Sarco for all steam traps and temperature control because in their years of experience in connection with many other jobs, there was no other line as broad and versatile and as reliable.

The illustration above shows the extent to which eight different but related Sarco products were used in this one plant, and the wide range of sizes required. Team work in operation was obviously secured.

Other advantages of standardization with Sarco are:

Ease of inspection and cleaning without disturbing the piping. Small number of spare parts required in stores. Ease of obtaining duplicates for additions or extensions, and the knowledge that all parts were made in one plant by one company.

WHEN YOU PLAN get the Sarco HOOK-UP BOOK which will show you how completely and satisfactorily Sarco products can serve your plant.



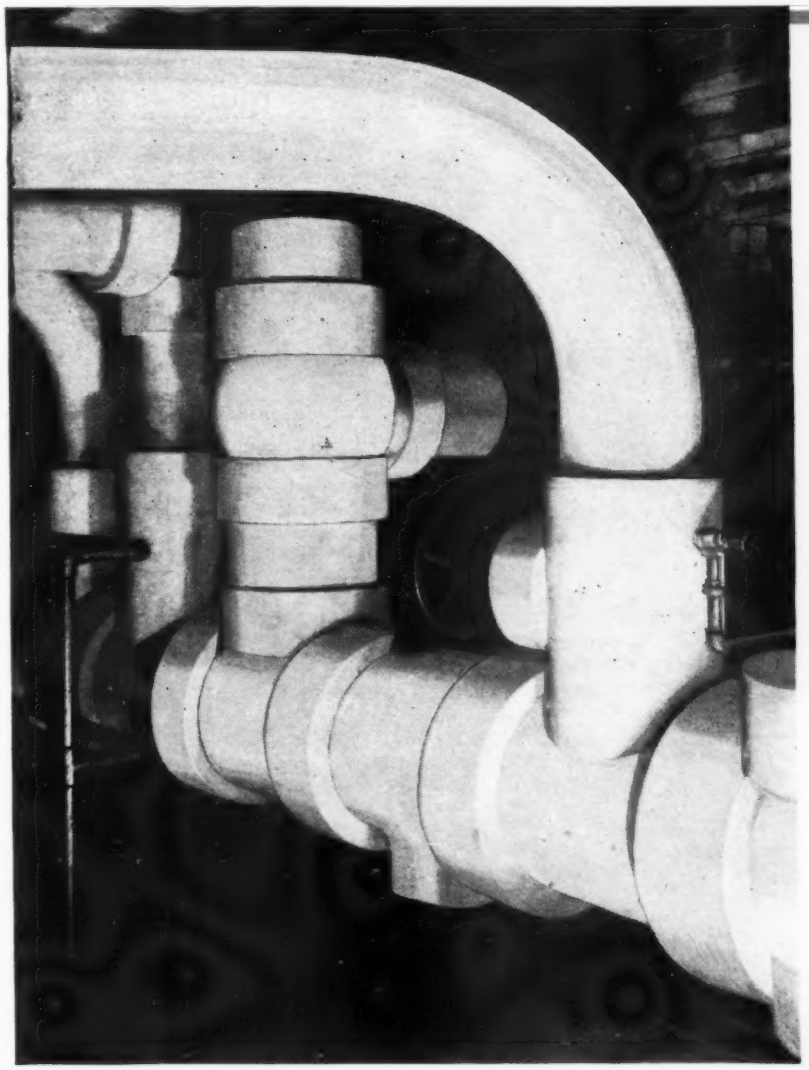
FOUR STARS ON OUR E PENNANT TESTIFY TO SARCO PERFORMANCE IN THE WAR EFFORT

SARCO SAVES STEAM

Represented in Principal Cities

SARCO COMPANY, INC., 475 FIFTH AVE., NEW YORK 17, N.Y. • Sarco Canada, Ltd., 85 Richmond St., W., Toronto 1, Ont.

You get all three essentials on time with this heat insulation service



CLOSE WORK, involving insulation of valve bodies, flanges, and flanged tees at the New Hampshire Gas and Electric Company, Portsmouth, N. H., was done neatly and quickly by Armstrong's Contract Service, Boston office. Exhaust header and piping were covered with a combination of high-temperature insulation and 85% magnesia, with sewed canvas jackets.

1. **MATERIALS.** Insulations of tested efficiency — a complete line covering every industrial temperature and condition—are used by Armstrong's Contract Service.

2. **ENGINEERING.** Armstrong's experienced staff is ready at all times to cooperate with you in writing specifications to meet every possible requirement, however unusual it may be.

3. **WORKMANSHIP.** Crews of trained Armstrong craftsmen, located in major industrial centers, apply your insulation in accordance with the best standards and practices to satisfy a rigid code of workmanship.

PROMPT SERVICE in meeting your heat insulation needs is an important advantage of Armstrong's Contract Service. Armstrong's skilled superintendents and trained mechanics are specialists in getting your job done in the shortest possible time. But quality is never sacrificed for speed. On all three essentials—materials, engineering, and workmanship—Armstrong follows through with scrupulous care, because it takes full responsibility for the entire job. Armstrong's Contract Service is located conveniently near you. Just phone any of the offices listed at the bottom of this page. Armstrong Cork Company, Building Materials Division, 7002 Concord Street, Lancaster, Pennsylvania.

ARMSTRONG'S INDUSTRIAL INSULATION

Complete Contract Service For All Temperatures

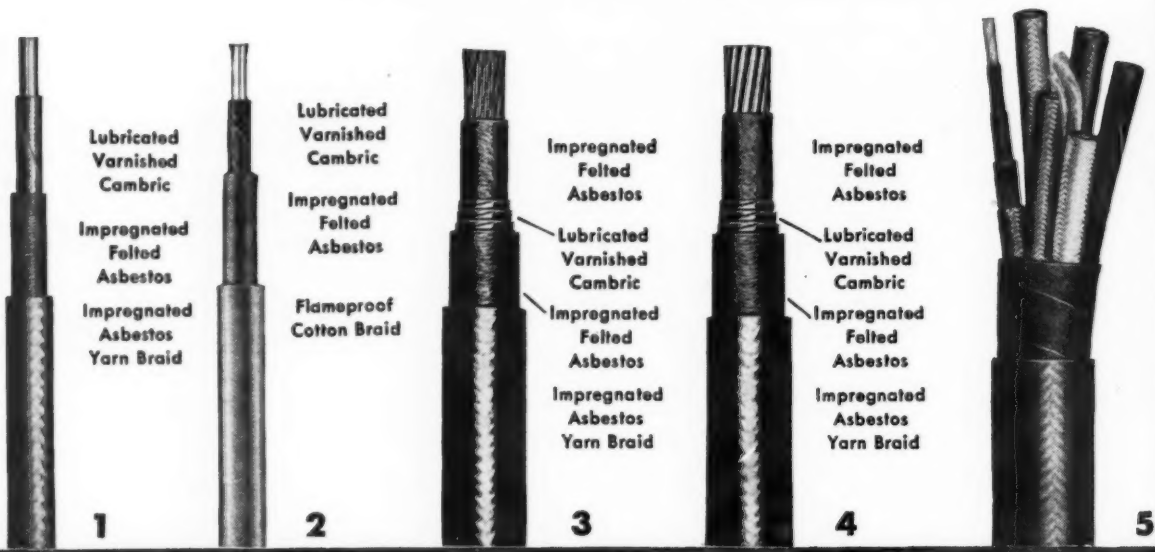
From 300° Below Zero

To 2600° Fahrenheit

ALBANY, N. Y. • ATLANTA, GA. • BALTIMORE, MD. • BIRMINGHAM, ALA. • BOSTON, MASS. • CINCINNATI, OHIO • CLEVELAND, OHIO
COLUMBUS, OHIO • DALLAS, TEXAS • DENVER, COLO. • DETROIT, MICH. • HARTFORD, CONN. • HOUSTON, TEXAS • INDIANAPOLIS, IND.
JACKSONVILLE, FLA. • KANSAS CITY, MO. • LOUISVILLE, KY. • MEMPHIS, TENN. • NEW ORLEANS, LA. • NEW YORK, N. Y. • PHILADELPHIA, PA.
PITTSBURGH, PENNA. • PROVIDENCE, R. I. • RICHMOND, VA. • ST. LOUIS, MO. • TULSA, OKLAHOMA • WASHINGTON, D. C.

5-POINT PROGRAM

for Eliminating Wire-Failures in Control, Power and Lighting Circuits exposed to Severe Operating Conditions



1. **National Electrical Code Type AVA** (max. operating temperature 230° F.) Rockbestos A.V.C. 600 Volt Boiler Room Wire in sizes No. 18 to 4/0 AWG. For lighting and control circuits around boilers, furnaces, steel mills, etc., and resistor wiring.
2. **National Electrical Code Type AVB** (max. operating temperature 194° F.) Rockbestos A.V.C. 600 Volt Switchboard Wire in sizes No. 18 to 4/0 AWG. For fireproof switchboard wiring. Takes right angle bends without cracking braid. Rockbestos A.V.C. Hinge Cable and Bus Cable also available.
3. **National Electrical Code Type AVA** (max. operating temperature 230° F.) Rockbestos A.V.C. 600 Volt Flexible Motor Lead Cable in sizes No. 18 AWG to 1,000,000 CM. For coil connections, motor and transformer leads exposed to heat and moisture, oil, grease and fire hazard.
4. **National Electrical Code Type AVA** (max. operating temperature 230° F.) Rockbestos A.V.C. 600 Volt Power Cable in sizes No. 18 AWG to 2,000,000 CM. For power circuits and hot-spot wiring in generating and industrial plants.
5. Rockbestos A.V.C. 600 Volt Multi-Conductor Control Cable in standard sizes, No. 12—19/#25 and No. 9—19/#22 (other strandings on order) with from two to nineteen conductors insulated the same as Rockbestos A.V.C. Power Cable except braids on individuals which are coded cotton.

Don't let tough conditions cause wire-failures that tie up equipment, slow down production and bump up maintenance expense . . . install *failure-preventing* Rockbestos A.V.C. in the trouble spots.

These National Electrical Code type *permanently insulated* Rockbestos developed wires are insulated with the time-tested combination of lubricated varnished cambric and *impregnated felted asbestos* that stands up under high ambient temperatures and conductor-heating overloads without baking brittle or flowing . . . without cracking under vibration . . . without rotting or swelling in contact with oil, grease or fumes . . . and without burning when exposed to flame.

Rockbestos A.V.C. has ample moisture resistance for conduit installations — and for dry high-temperature applications there are many other *permanently insulated* Rockbestos All-Asbestos (N. E. Code Types) wires, cables and cords in our line of 125 different standard constructions. Specify them for long and dependable service under severe conditions in boiler rooms, steel mills, steam tunnels, power plants . . . and around furnaces, kilns, lehrs, steam lines, ovens or other hot spots.

For a catalog, samples or recommendations write nearest district office or:

Rockbestos Products Corporation, 123 Nicoll Street
New Haven 4, Connecticut

ROCKBESTOS A.V.C.

The Wire with Permanent Insulation

NEW YORK, BUFFALO, CLEVELAND, CHICAGO, PITTSBURGH, ST. LOUIS, LOS ANGELES, SAN FRANCISCO, SEATTLE, PORTLAND, ORE.

MACHINE TOOL CONTROL

built to Specification

New electrical standards for machine tools have been announced after joint conference of the National Machine Tool Builders' Association and representatives of large users (primarily among the automotive industry). Characteristic construction features required are shown below. Requirements peculiar to the automotive industry are shown in *italics.*

ENCLOSURE: NMTBA:
Semi-dust tight (NEMA Type IA) enclosure has no unfilled holes when mounted.

Hinged cover swings horizontally and has adequate means for fastening in closed position.

AUTOMOTIVE:

Enclosure with no holes necessitates external mounting feet.

Cover must be held closed with bolts or screws which require the use of a tool to remove.

REDUCED VOLTAGE CONTROL CIRCUITS: NMTBA:
110 volt control circuit is obtained from a transformer with isolated secondary winding protected by fuses or equivalent overcurrent protective devices.

All operating coils of magnetic devices are connected to the same side of the control circuit with no contacts interposed except overload relay contacts. A terminal is provided on panel for grounding coil side of transformer secondary if conditions permit.

AUTOMOTIVE:

Additional transformer capacity is provided for a 100 watt, 110 volt machine light.

Transformer will have dual primary winding for 220/440 volts unless otherwise specified.

DISCONNECT SWITCH: NMTBA:
NEMA Type A Manually operated, non-fusible switch or circuit breaker disconnects are arranged to be locked in "OFF" position and are mechanically interlocked with control enclosure door. Fusible disconnect switches are available when specified.

PANEL WIRING: NMTBA:
Wires are supported mechanically where necessary to keep them in place.

Terminals are provided for all outgoing wires.

Terminal markings correspond with the markings on the wiring diagram. Wire insulation is synthetic compound, not less than 3/64" thick. Load and control circuits are distinguished by color.

BASE PLATE: NMTBA:
All front connected devices are mounted on rigid base plate to permit removal of complete control panel.

Ample room is provided between base plate and enclosure for proper maintenance and electrical clearance.

WIRING DIAGRAMS: NMTBA:
Attached to inside of control enclosure door by adhesive material or permanent data pocket, depending on size.

Elementary diagram is included on wiring diagram.

CONTROL DEVICES: NMTBA:
Devices such as motor starters, contactors, timers, etc. are built to ASA and NEMA standards and are designed to facilitate combination into special control panels.

AUTOMOTIVE:

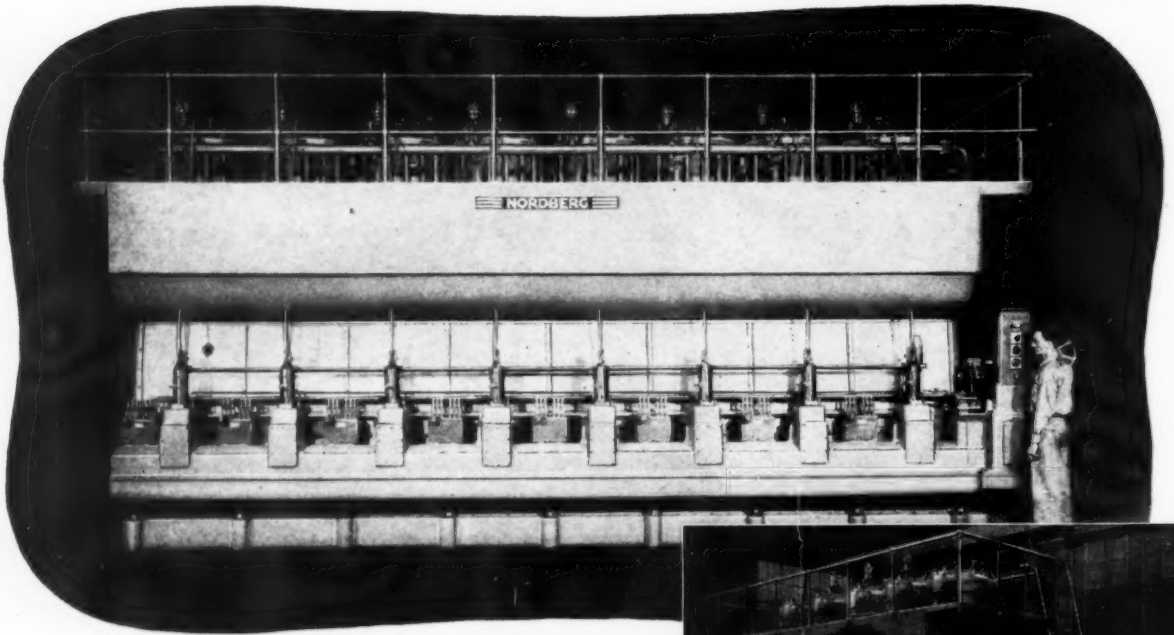
No starter smaller than Size 1 used on any motor.

SQUARE D is prepared to build control to NMTBA and Automotive Standards or any other specification developed to promote safety of personnel, uninterrupted production and long life. Square D Field Engineers, stationed in branch offices in all principal cities, are thoroughly qualified to assist in the design and application of such control.

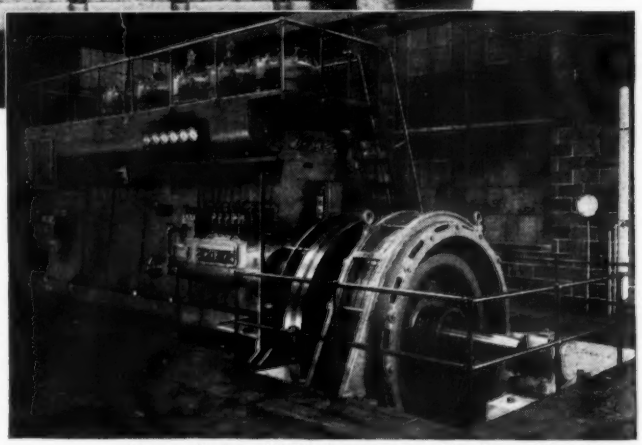
SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

Another NORDBERG DIESEL for SIKESTON, MISSOURI



This new eight cylinder, 3200 horsepower unit when installed will drive a flywheel type generator of 2250 K.W. capacity.



Five cylinder, 1250 horsepower Nordberg Diesel engine driving a 870 K.W. generator installed in 1935.

FOR the second time, Sikeston, Missouri when confronted with the need of installing additional generating capacity in its city-owned electric utility has selected a larger Nordberg, two-cycle Diesel engine. This engine embodies the latest improvements in design and construction. A new feature is the use of a motor-driven centrifugal type blower for scavenging purposes instead of a scavenging pump or attached blower; hence the engine has been substantially shortened which permitted a larger engine being installed in the available space.

If your power requirements call for greater generating capacity or a more dependable, low cost source of supply, let Nordberg engineers discuss that power problem with you. Two-cycle and four-cycle engines available in sizes up to 8500 H. P.

NORDBERG MFG. CO., MILWAUKEE 7, WIS.

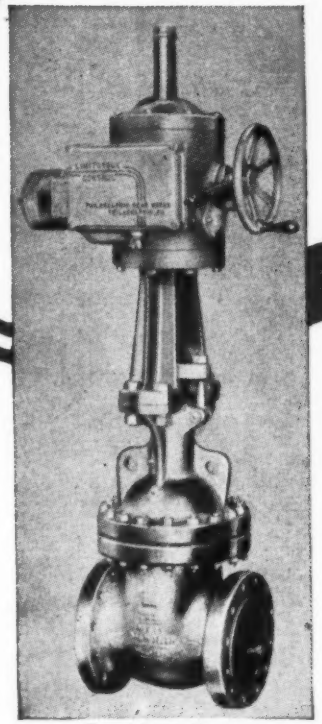
NORDBERG DIESEL ENGINES

Push-Button CONTROL OF VALVES

The Word "LimiTorque" has a definite meaning, because an exclusive patented Torque Switch actually limits the torque applied to the operating parts.

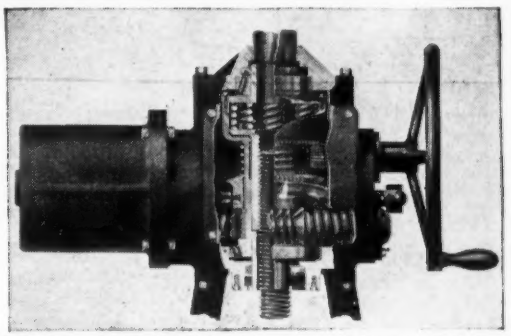
with LimiTorque VALVE CONTROL

On extremely hot or cold lines,—in the most out-of-the-way places,—indoors or outdoors,—nearby, or miles away, *all valves can be instantly, safely and dependably* closed by LimiTorque.



Type "S" LimiTorque

By a push on a button, the opening and closing operations of valves of all types are speeded up, while labor costs are simultaneously reduced. Doors, damper controls, sprinkler systems, feeder disconnect switches, marine ventilating covers, watertight bulkhead doors, as well as Gate, Globe, Butterfly, Plug valves and sluice gates can be easily and automatically operated.



DESCRIPTION OF OPERATION: Motor is coupled to worm shaft through helical gears. In closing, worm drives worm gear until lugs on gear meet matching lugs on clutch. Torque is transmitted to the nut through splines connecting the clutch to sleeve and nut. When valve disc reaches its seat, the impact is absorbed by expansion springs. Torque spring is then compressed by axial movement of worm on worm shaft. When torque spring has been compressed to predetermined setting, torque switch is actuated by a tripping collar on worm shaft . . . this interrupts current to holding coil of controller and stops motor. Inertia of motor is absorbed in further compression of torque spring. The opening travel is governed by geared limit switch.

ARMY NAVY

Philadelphia GEAR WORKS INCORPORATED

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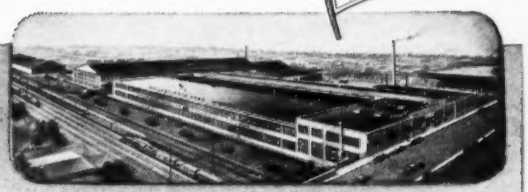
IN CANADA: WILLIAM & J. G. GREEY LIMITED, TORONTO.



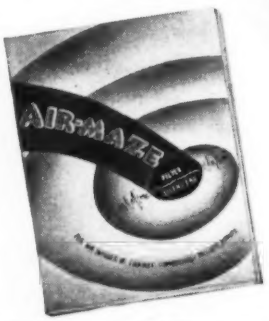
Industrial Gears and Speed Reducers
LimiTorque Valve Controls

Silencing and *EFFICIENT FILTRATION*, too!

Air-Maze ENGINEERED Filter-Silencers Both CLEAN and QUIET Intake Air!

New Catalog!

Gives data on various filter-silencers, tells how to select the correct model for your particular application. Specification tables are keyed to all types of blowers, engines and compressors. Send for Catalog No. FSC-246 today!



Sure, quiet the intake air of your blowers, engines and compressors—but *protect* that expensive equipment, too!

Efficient air filtration of dirt and grit in intake air enormously lengthens the life of valves, cylinder liners, bearings and other moving parts of your equipment. That is why *every* Air-Maze air silencer is *combined* with an efficient air filter—*one* unit that solves *both* problems!

This is typical of the more than 3000 types and sizes of filters engineered by Air-Maze during the past 20 years—*specific* filtration problems solved by *continuous research*. Bring your filtration problems to our engineers for the right solution.

AIR-MAZE CORPORATION, *Cleveland 5, Ohio. Representatives in principal cities. In Canada: Williams & Wilson, Ltd., Montreal, Quebec, Toronto, Windsor; Fleck Bros., Ltd., Vancouver, B. C.*

IF IT USES AIR . . . USE

AIR-MAZE

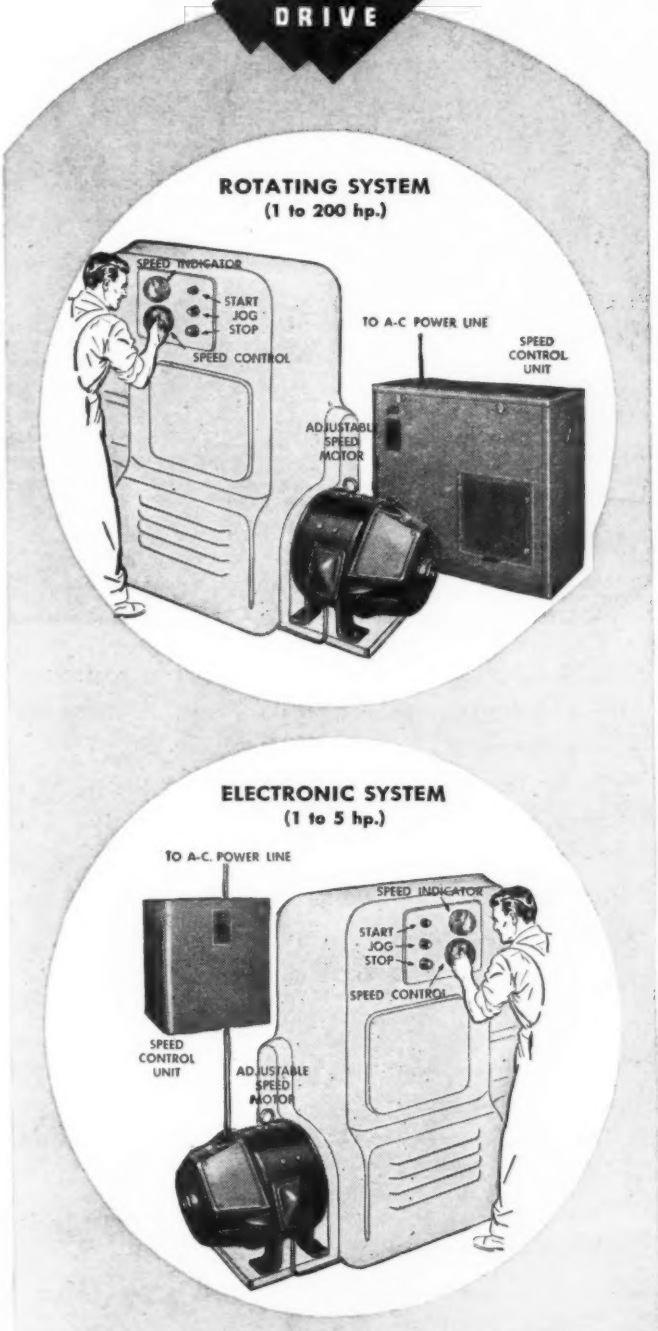
ENGINEERED AIR FILTRATION

• Oil bath type filters and filter-silencers • Cleanable filter panels for air-borne dirt, oil, grease and liquids • Oil-wetted type filters and filter-silencers • Exhaust spark arresters • Gear case, crankcase and tank vent breathers • Oil-separators for engine crankcases • Full-flow type cleanable oil filters

Why pay more than you need

RELIANCE V★S DRIVE

to get D-c. Power where you want it?



Save $25 to $60 per Kilowatt of installed D-c. capacity with RELIANCE V★S DRIVE

If in your plant—as in so many others—there is a need for supplying D-c. power for adjustable-speed operations, you are likely to find that *spot conversion of A-c. power* with the Reliance V★S Drive is the perfect answer. This is true for two reasons.

FIRST—V★S DRIVE saves you from $25 to $60 per kilowatt as compared to the cost of bringing in and applying D-c. power from some central source. These figures are based on a wide variety of applications.

SECOND—V★S DRIVE gives you unlimited flexibility of machine operation and application. This includes both automatic and manual control with smooth starting, stopping and reversing. Also, an infinite range of stepless speed changes, automatically maintained tension and many other specialized advantages.

Before installing D-c. power lines, learn what you can save with Reliance V★S Drive, which operates from your regular A-c. circuits. And see what V★S, with all-electric control, can do in improving quality and quantity of output, while reducing installation, operating and maintenance costs. Write today for the up-to-date story on spot conversion of A-c to D-c power.

RELIANCE ELECTRIC & ENGINEERING CO.
1068 Ivanhoe Road • Cleveland 10, Ohio

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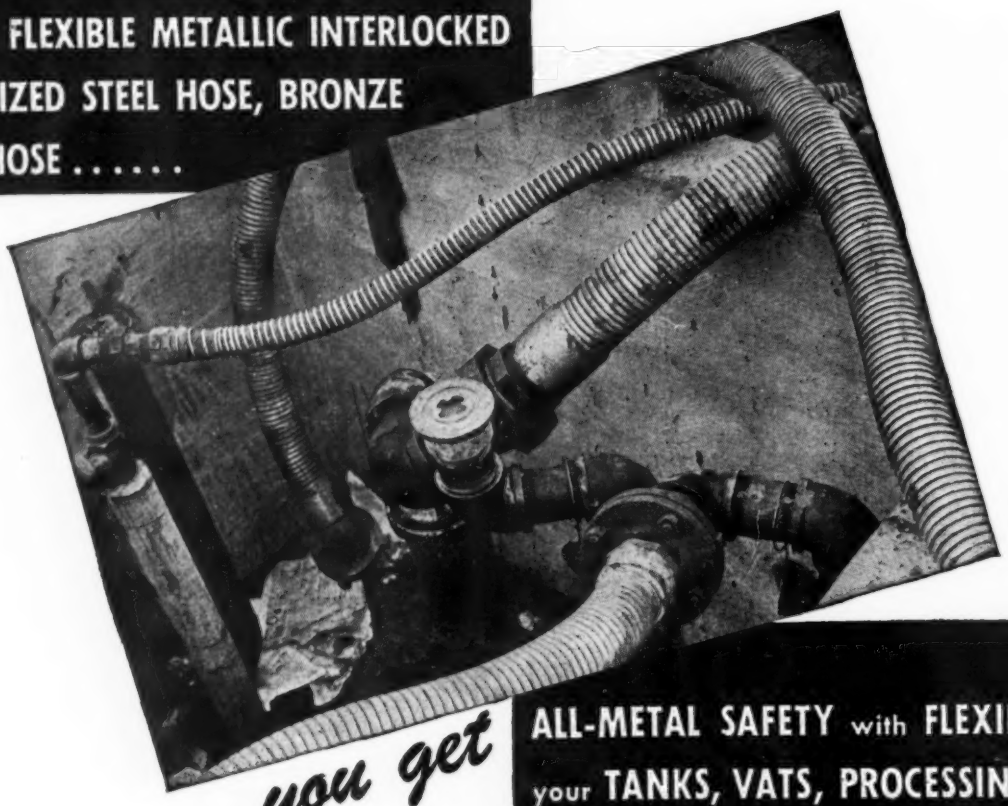
Tampa • Washington, D. C.

RELIANCE A-C D-C MOTORS

"Motor-Drive is More Than Power"

with

PENFLEX FLEXIBLE METALLIC INTERLOCKED GALVANIZED STEEL HOSE, BRONZE STEAM HOSE . . . . . .



you get

ALL-METAL SAFETY with FLEXIBILITY for your TANKS, VATS, PROCESSING EQUIPMENT and PIPE SYSTEMS

PENFLEX—Four-wall Interlocked gives you high resistance to wear, absorption and fire. It is vibration-absorbing . . . severe pulsations of pressure and frequent flexure do not affect its useful life. Four-wall Interlocked construction provides a combination of great strength and flexibility, yet *the metal itself does not bend* . . . the hose remains tight. Full flow area is always maintained; this hose cannot collapse.

AVAILABILITY—*PENFLEX GALVANIZED STEEL HOSE* — for oil, grease, hot tar, paint, gas, air or any other free-flowing material or liquid. Fire-resistant. Has inherent electro-static protection. Is easy to handle. Resists vibration and high temperatures. Is strong and flexible.

PENFLEX BRONZE HOSE—for water or steam, and for many types of application on processing equipment. Has all of the advantages of galvanized steel and is resistant to corrosive action. NOTE: Also available in various alloys.

THREE BASIC TYPES—*STANDARD FOUR-WALL INTERLOCKED*—for heavy duty service. Interlocked construction provides maximum strength with simple construction.

TYPE HR HIGH RIDGE—medium duty hose. High ridge joint affords greater relative motion between corrugations than does the Standard Four-wall Interlocked.

TYPE FP LIGHTWEIGHT—most flexible hose. An extremely flexible construction with lubricated packed joints.

All of the three types can be reinforced by the addition of braiding and armor.

PENFLEX COUPLINGS—Available in two types

SOLDERED-ON TYPES for use at temperatures to 250 degrees Fahrenheit and *HEAT-PROOF TYPES* for temperatures above 250 degrees Fahrenheit.

Both types can be supplied in brass or malleable iron . . . plain or reinforced.

For engineering data on PENFLEX GALVANIZED STEEL, BRONZE HOSE and COUPLINGS—write for Bulletin 52-9.

PENFLEX

PENNSYLVANIA FLEXIBLE METALLIC TUBING CO.

Established 1902

7215 POWERS LANE **PHILADELPHIA 42, PA.**

NEW . . .

16-PAGE BOOKLET!

covering

- OPERATION
- ADVANTAGES
- CONSTRUCTION
- APPLICATION

of the

MAGNETIC DRIVE

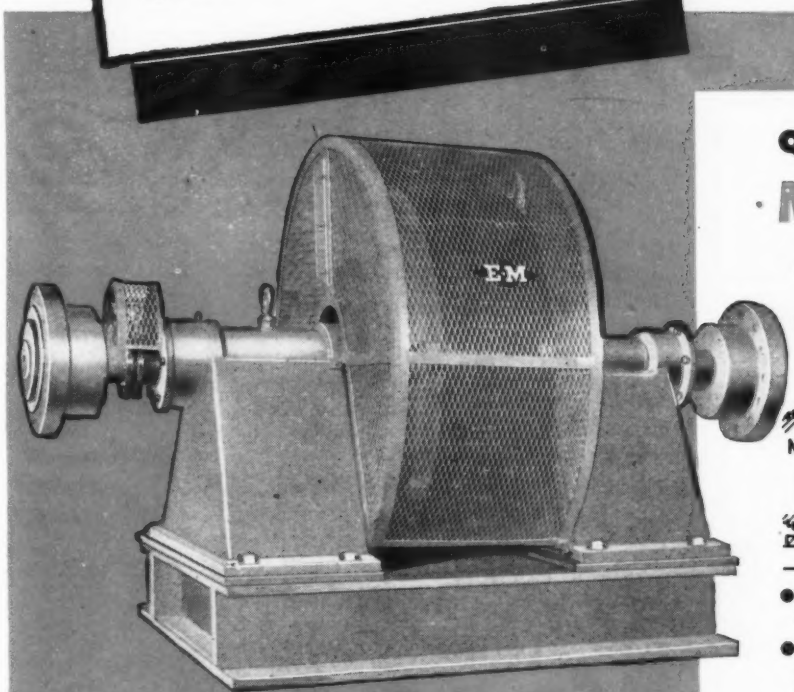
WRITE TODAY . . . for your copy!

TODAY's answer to how to get correct, economical speed control for boiler draft fans is the E-M *Magnetic Drive*. A compact, electro-magnetic torque-transmitting device, the *Magnetic Drive* is installed between a constant-speed motor and the fan, and operates in combination with automatic boiler draft control.

The result: *precise, quick-response, adjustable speed* of boiler draft fans from maximum speed down to 10% of motor speed.

The *Magnetic Drive* permits the fan to be operated at minimum speed for given output, reducing fan wear due to erosion, lowering power consumption and operating costs. Simple in construction, the *Magnetic Drive* uses no fluids which may produce dirt or fire hazards, requires no vane control of fans. You get quick speed response, over the wide range of speeds. The *Magnetic Drive* is as ruggedly built and as dependable as a motor. See your E-M field engineer now about this newer, better method of boiler draft speed control.

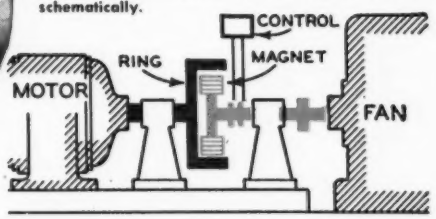
ELECTRIC MACHINERY MFG. CO.
MINNEAPOLIS 13, MINNESOTA



SEND FOR NEW ILLUSTRATED BOOKLET NO. 183 DESCRIBING THE MAGNETIC DRIVE

QUICK FACTS ABOUT THE Magnetic Drive

- The E-M Magnetic Drive is a simple, compact, electro-magnetic torque-transmitting device.
- It consists essentially of a ring, driven by the motor, and a magnet coupled to the fan, as illustrated schematically.



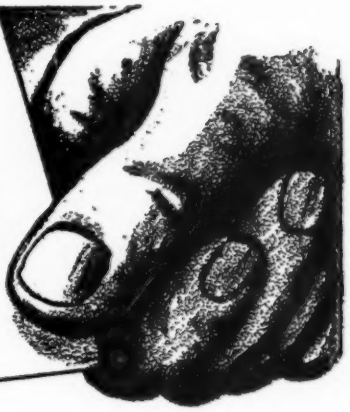
- Closely adjustable-speed from maximum down to 10% of motor speed . . controlled electronically.
- Advantages: Precise fan speed control — Maximum fan power economy — Minimum fan wear from erosion — Quick speed response — Simple rugged construction.

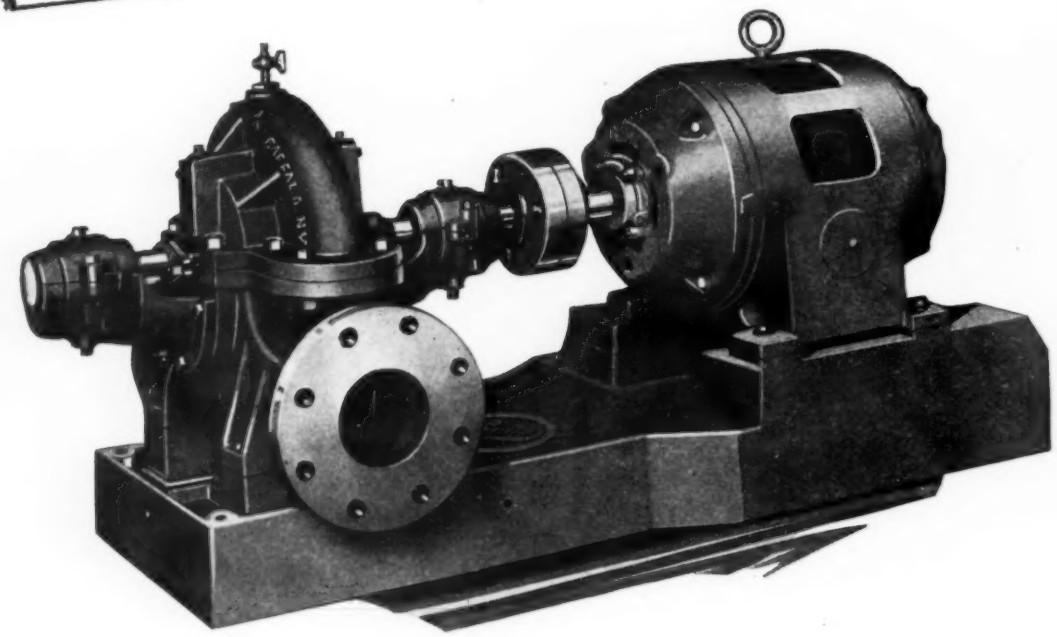
E-M

Adjustable-Speed MAGNETIC DRIVES

Pay for themselves through better boiler control, longer fan life, and power savings!

• POWER ECONOMY
• LOW MAINTENANCE
• LONG LIFE





If you are interested in low cost operation of pumps for general service, you'll want full details on Buffalo "SL" Pumps, the heavy-duty double suction single stage pumps which boast satisfied users "around the world".

Made in a complete range of sizes for capacities up to 10,000 gpm, "SL" Pumps offer moderately priced fine performance.

Why not send for Buffalo Bulletin 955 which gives complete details?

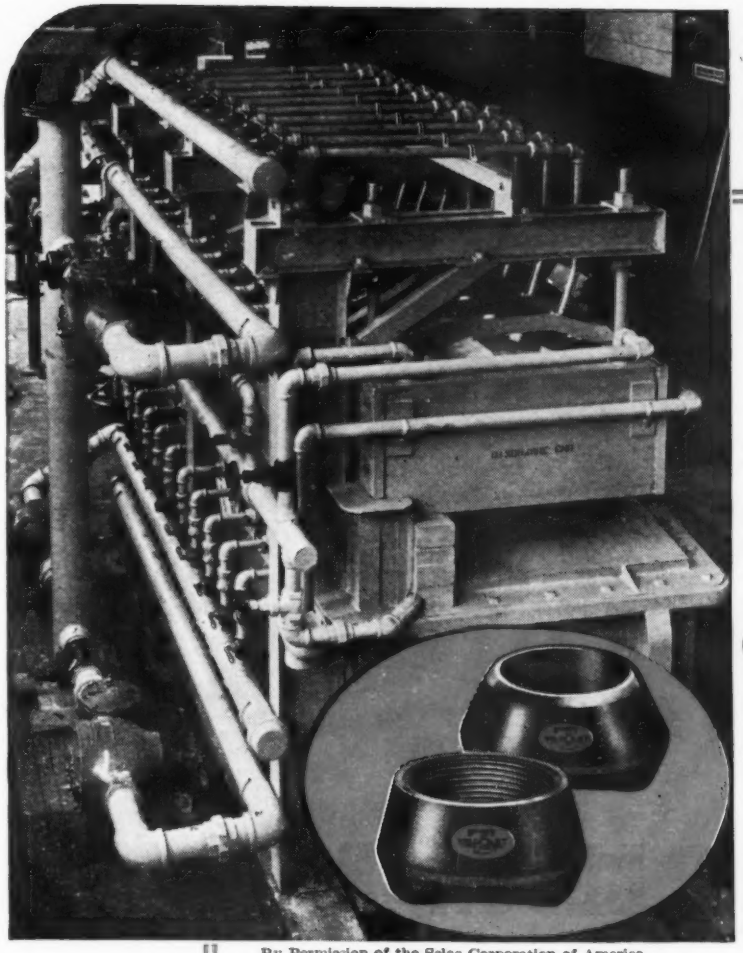
Buffalo Pumps, Inc.

488 Broadway **Buffalo, N. Y.**

Canada Pumps, Ltd., Kitchener, Ont.

"Buffalo"

Double-Suction Single Stage
Class "SL" Pumps



By Permission of the Selas Corporation of America

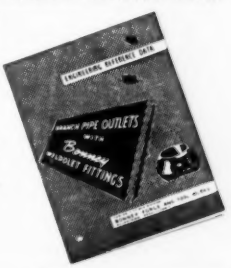
How to Reduce Pressure Loss

IN PIPING SYSTEMS

HOW to reduce pressure loss at right-angle branch pipe outlets has always been a problem to piping engineers. The reason for this pressure-drop is the abrupt change in the direction of flow which creates excessive turbulence at the joint. This turbulence tends to cause "dead-spots" which restrict flow into the branch line.

WeldOlet Fittings overcome this problem because they are designed with a funnel-shaped inlet. This funnel-shaped inlet reduces turbulence and provides greater flow area into the branch line. Pressure-loss is reduced and flow-efficiency is increased.

The accompanying illustration of a continuous gas furnace shows how the SELAS CORPORATION OF AMERICA uses WeldOlet Fittings on gas manifolds feeding burner lines. The use of these fittings reduced pressure loss and provided the desired burner efficiency.



Get full information on these more efficient, easier to install fittings today. Write for a copy of the new WeldOlet Fittings Catalog.

Forged Fittings Division

BONNEY FORGE & TOOL WORKS • 342 Green Street, Allentown, Pa.

BUY MORE BONDS AND KEEP THEM

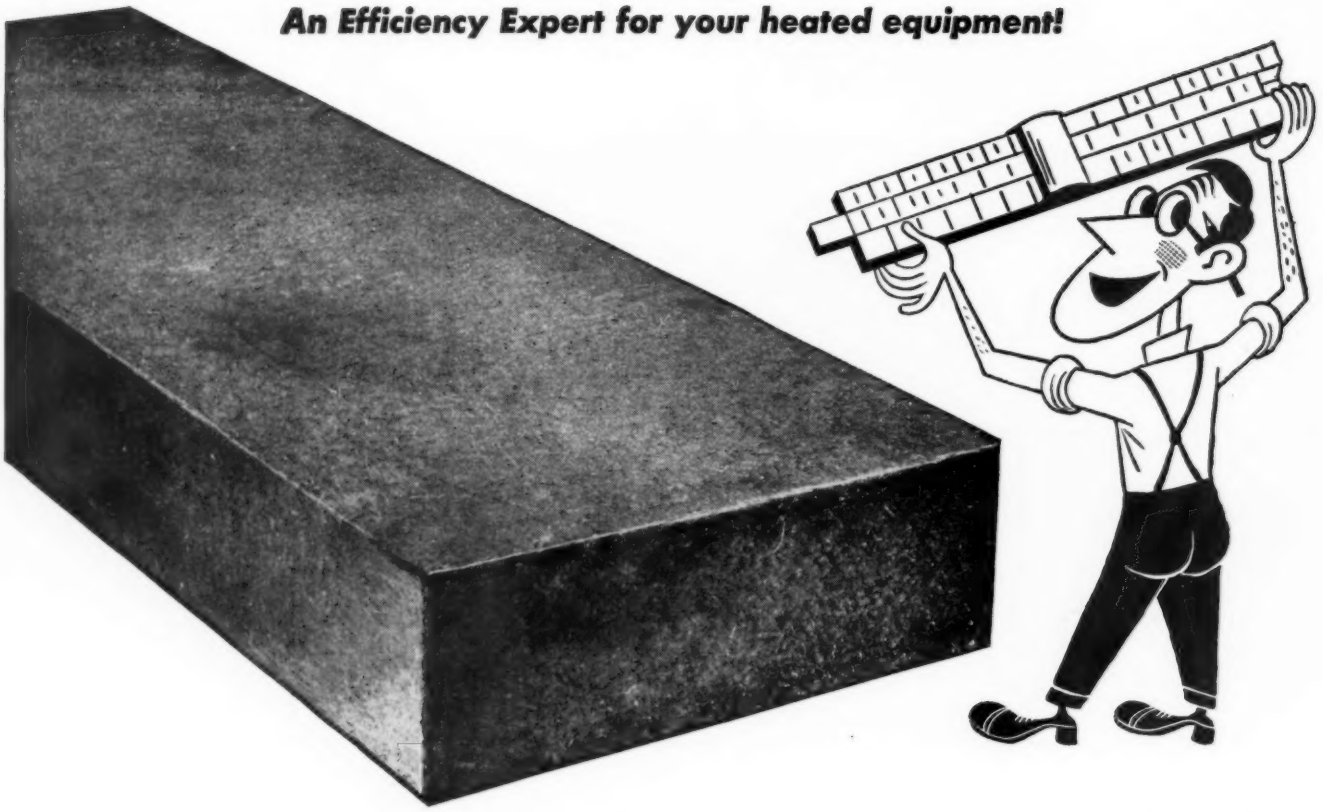
WELDOLETS

TRADE MARK REG. U. S. PAT. OFF. PAT. IN U. S. & FOREIGN COUNTRIES

WELDING OUTLET - THREADED OUTLET - SOCKET OUTLET

For Welded Branch Pipe Outlets

An Efficiency Expert for your heated equipment!



EAGLE SUPERTEMP BLOCK INSULATION

As a low cost, all-purpose block insulation, Eagle Supertemp prevents heat loss and steps up the efficiency of boilers, heat treating furnaces, turbines, hot air ducts, hot water tanks, ovens, and other heated equipment.

Because it is composed principally of Eagle Mineral Wool, Eagle Supertemp Block is literally honeycombed with dead air cells, one of the best heat insulators known to science. This unique insulation withstands a full range of temperatures up to 1700° F. The chemical and physical stability of Eagle Supertemp Block makes its low thermal conductivity permanently effective. This insures continuing savings long after the initial cost has been repaid.

Installs Quickly

Eagle Supertemp Block has ample structural strength to withstand all normal handling and usage. It can be installed quickly, cuts easily with knife or saw, and fits snugly over minor irregularities, such as rivet heads.

Virtually fireproof and highly moisture-resistant, Eagle Supertemp Block contains nothing to cause rust or corrosion, most important these days when so much metal equipment is impossible to replace.

To speed application of Eagle Supertemp Block, we suggest Eagle Insulstic, a strong, paste-like adhesive that holds insulation in place until a permanent support can be added.

Other Eagle Industrial Products Include:

Eagle Insulseal. A protective coating for insulation. Trowels on—dries to a hard finish. Withstands up to 450° F.

Eagle Swetchek (Black). A prepared, asphaltic base, rust-inhibitive, anti-condensation compound.

Eagle Drycote (White). A dry, ready-to-mix, rust-inhibitive anti-condensation compound.

Eagle "43" Finishing Cement. A hard, white finish coating for all types of indoor insulation within a range of from 70° F. to 800° F.

FREE MANUAL!

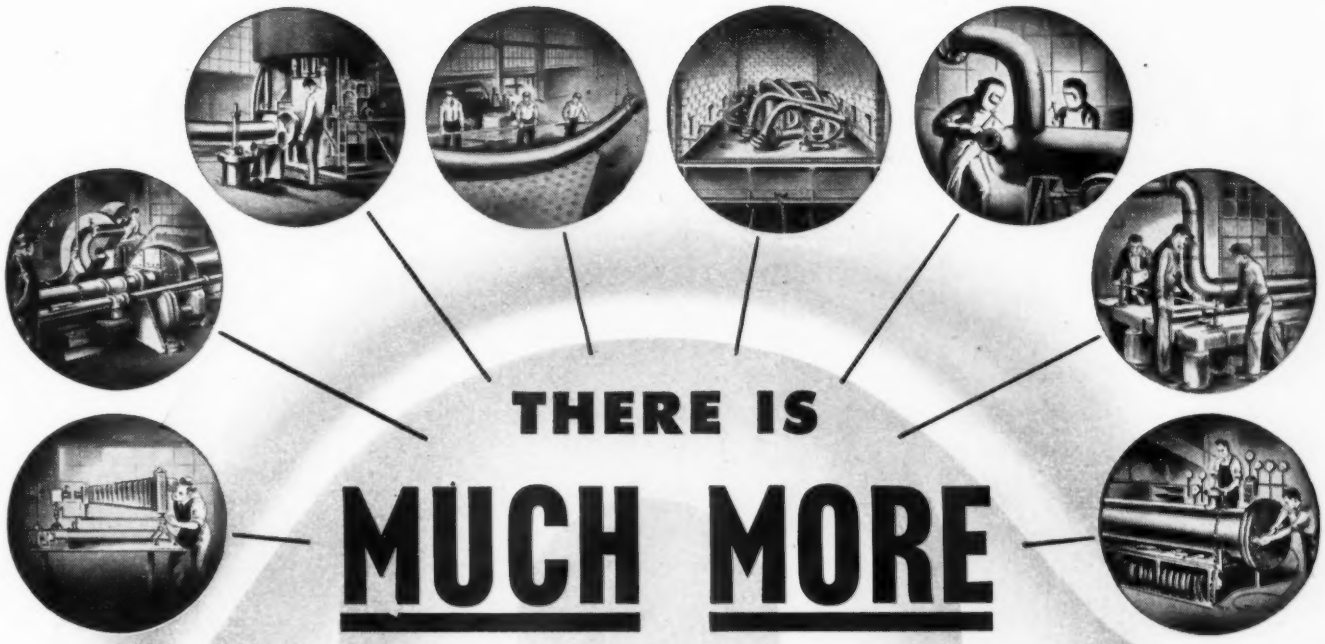
Gives case examples of how industrial insulation effects large fuel savings. Includes Heat Loss Estimate Sheet for your use. Write for your copy.

EAGLE-PICHER INSULATIONS
High and Low Temperature

EAGLE EP PICHER

Made by THE EAGLE-PICHER COMPANY • CINCINNATI (1), OHIO

Eagle Super "66" Insulating Cement • Eagle L-T and M-2 Felt • Eagle Supertemp Block • Eagle Blankets • Eagle Pipe Covering
Eagle Insulseal • Eagle Loose Wool • Eagle Insulstic • Eagle Swetchek • Eagle Drycote



THERE IS MUCH MORE TO PRE-FABRICATED PRESSURE PIPING THAN MEETS THE EYE

Straight pipe—bends—laps—fittings—valves—flanges—welds . . . these are the things that meet the eye in a pre-fabricated pressure piping subassembly.

What isn't seen is the skill, experience and the technical development that went into the making of a seemingly simple pre-fabricated piping subassembly. It requires years to develop a pipe bender capable of producing consistently satisfactory bends. Pressure pipe welders are the result of long and careful training followed by qualification tests. The amount of special equipment used is astonishing to the man not familiar with pipe fabricating plants; there are layout tables, form cutting machines, work rotating fixtures, preheating and stress relieving equipment, straightening tables, testing facilities, etc.

This equipment and the skill to make best use of it are found in the shops of qualified pipe fabricators. Hence, they can save the user time and trouble and money on piping.

THE PIPE FABRICATION INSTITUTE

P.F.I. THE PIPE FABRICATION INSTITUTE

Devoted to the Technical and Economic Problems in Piping

1108 CLARK BUILDING, PITTSBURGH, PA.

G-3

YOUR SAFETY DESERVES THE PROTECTION OF A *Farris* SAFETY VALVE

HERE'S A PRECISION-OPERATING VALVE FOR SERVICE UP TO 600 LBS.—750°F.

You're looking at the FARRIS type 2575 Full Venturi Safety Valve. Its design was determined *by actual field service*—without consideration of manufacturing standardization...

Type 2575 combines all the outstanding advantages of FARRIS design such as the one-piece Venturi port (which also forms the gasket face) . . . secondary orifice with preselected capacity . . . single blow-down ring . . . center-guide bushing . . . separator bell . . . dual test-lever. Six *advanced* features that spell unprecedented boiler safety!

When you specify a FARRIS type 2575, you get a precision-operating instrument . . . you get minimum blow-down, non-shock operation . . . and rapid, high-capacity relief of overpressure.

You owe it to the safety of your whole plant to specify a safety valve of the most advanced design and construction available.

So why not write for the new *FARRIS catalog NOW—while our address is before you.*

FE-524

WRITE TODAY FOR THE *New* FARRIS CATALOG

FARRIS ENGINEERING COMPANY
366 Commercial Ave., Palisades Park, N. J.

Farris
SAFETY and RELIEF VALVES

FARRIS KEEPS PACE WITH ADVANCING POWER AND PROCESS ENGINEERING

BELIEVE IT OR NOT . . . IT'S ONE PIECE!

This heavy, curved welding neck looks like several fittings welded together. That would be the easy way to make it, but the particular condition it serves requires a one-piece forging.

Turning out a hollow forging like this—involving a flanged, curved, and upset section—is a tough undertaking. And yet it is typical of the kind of jobs that many people feel we are better qualified to handle than any other forging plant.

Yes, doing things with hot metal that nobody else does—knowing how to control its flow under pressure and impact — has been our specialty here for a good many years.

It is the "know-how" acquired in these special undertakings that explains why we are able to make WeldELLS and other Taylor Forge welding fittings, the fittings that have "everything" . . . why you find in WeldELLS extra metal properly distributed where service stresses are greatest . . . why WeldELLS have tangents . . . why all dimensions are so extremely accurate.

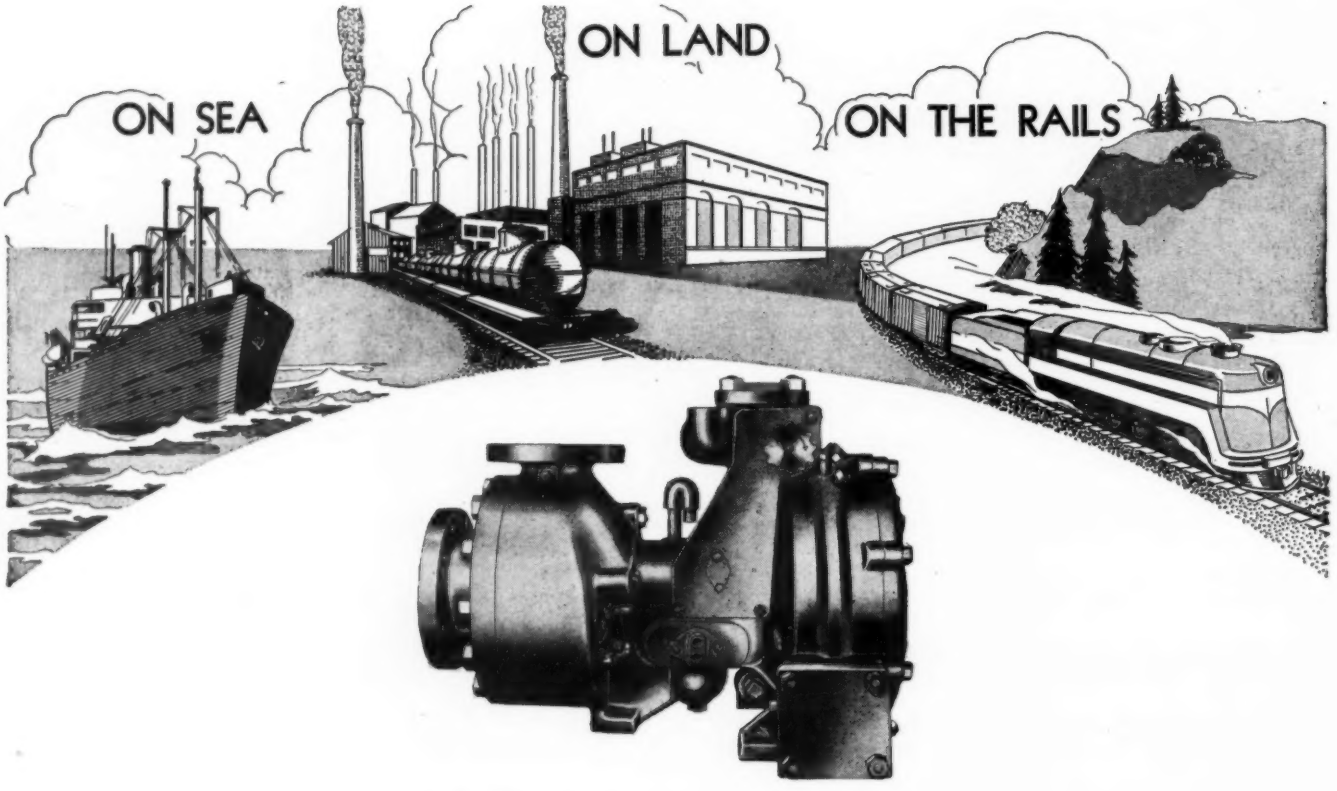
Just check the list of features, opposite, and we believe you will agree that WeldELLS indeed have everything conducive to sound engineering and utmost economy in every pipe welding job.

No other fittings for pipe welding combine these features found in WeldELLS:

- **Seamless** — greater strength and uniformity.
- **Tangents**—keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends**—simplify layout and help insure accuracy.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World** — insures complete service and undivided responsibility.

WeldELLS have everything

TAYLOR FORGE & PIPE WORKS, General Offices & Works: Chicago, P. O. Box 485
New York Office: 50 Church Street • Philadelphia Office: Broad Street Station Bldg.



COFFIN—*Steam Turbine* CENTRIFUGAL PUMPS

Feed The Nation's Boilers

As its name implies, the Coffin Steam Turbine Centrifugal Pump is a combination of both centrifugal pump and steam turbine.

These elements are mounted on a common shaft. This eliminates alignment difficulties and saves space and weight.

Since both elements are designed and selected to function as a single unit, high efficiency and low steam consumption are achieved.

All wearing parts are made to precision gauge tolerances and one hundred per cent interchangeability is maintained. This insures a long, economical service life.

These pumps are available for capacities up to 500 G.P.M. and pressures up to 750 P.S.I.

We invite your inquiries.

THE J. S. COFFIN, JR., COMPANY
ENGLEWOOD, NEW JERSEY

Mail the Coupon

Please Send Descriptive Bulletin 1-22

NAME _____

COMPANY _____

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P.W.

THE NEW U. S. GAUGES have radical improvements, offered for the first time to industry! Precision accuracy retained as always—but functional styling by one of the country's outstanding designers, in collaboration with our own engineers, has produced a complete line of gauges infinitely superior . . . in *appearance* . . . in *readability* . . . in *sturdy construction*.

Notice the colors, the visibility of graduations, the pleasing lines. Inspect the individual working parts and you will see the product of years of good engineering and research effort, resulting in longer life under adverse operating conditions, and incorporating higher quality and durability.

These significant advances are important to you as a user! For years, 6 out of 10 manufacturers of original equipment have specified U. S. Gauges. This ratio is bound to grow.

UNITED STATES GAUGE, SELLERSVILLE, PA.

USG

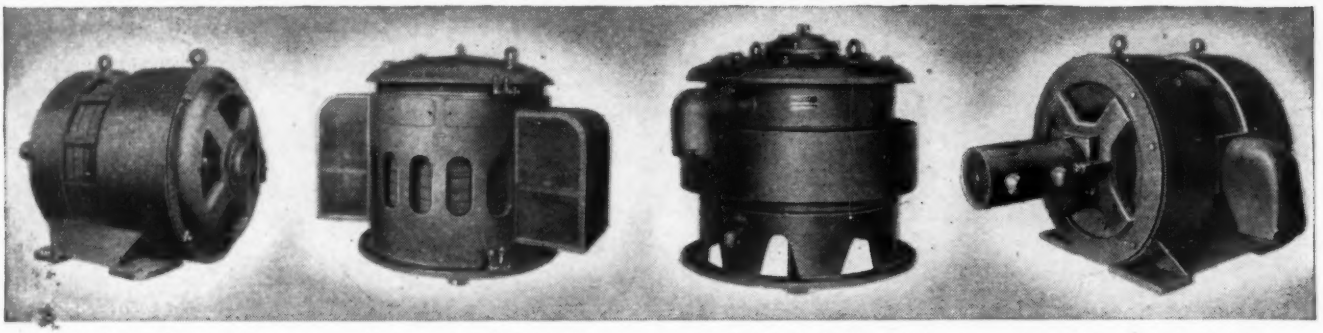
UNITED STATES GAUGE

DIVISION OF AMERICAN MACHINE AND METALS, INC.

Manufacturers of Pressure, Temperature, Flow and Electrical Measuring Instruments

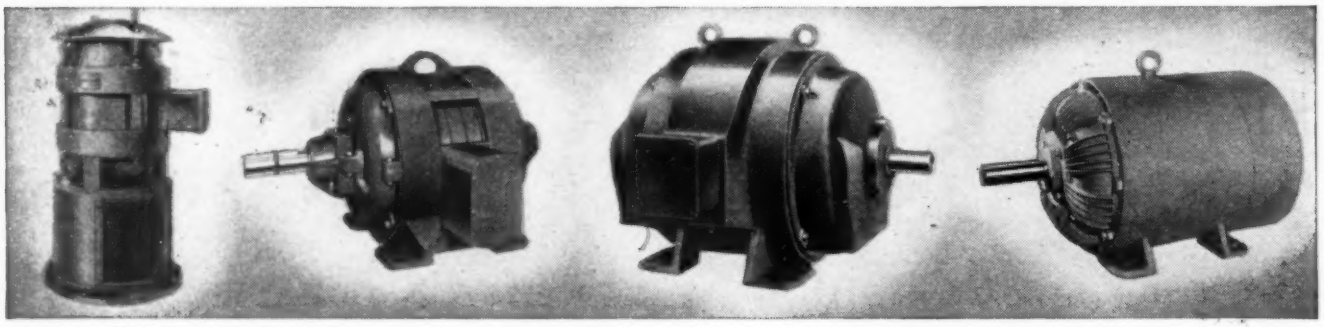
THERE'S ONE CORRECT INDUCTION MOTOR

• *that best fits into your plant*



200 Hp. Induction Motor | 400 Hp. Vertical Ind. Motor | 200 Hp. Squirrel Cage Vertical Ind. Motor | 300 Hp. 4-Speed Squirrel Cage Ind. Motor

25 Hp. Vertical Ind. Motor | 250 Hp., 1800 r.p.m. Ind. Motor | 30 Hp. Splash-proof Ind. Motor | 40 Hp. Fan Cooled Ind. Motor



BURKE INDUCTION MOTORS assume all kinds of types and sizes to meet specific conditions. They may be *Squirrel Cage*, with normal torque—normal starting current; normal torque, low starting current; high torque, low starting current or high torque, high slip. They may be *Wound Rotor* with constant or varying speed.

They may be multi-speed, drip and splash-proof, enclosed, enclosed fan cooled, vertical, flange, round frame and in sizes from 1 to 1500 H. P.

Consult with Burke engineers for that correct high quality induction motor *designed for the job.*

For a description of the complete Burke line of AC and DC motors and generators, consult Sweet's Engineering catalogs or Electrical Buyers Reference catalog.

For immediate assistance, telephone our nearest representative:

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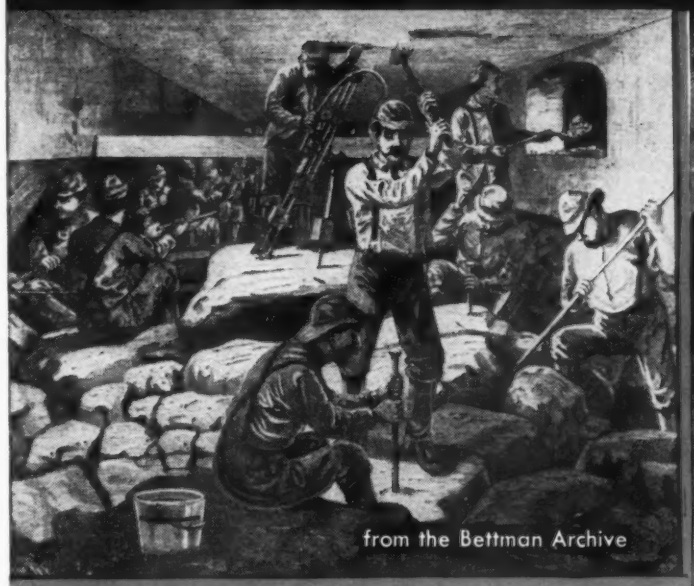
MOTORS 1 TO 1500 H. P. • GENERATORS 1 TO 1000 K. W.

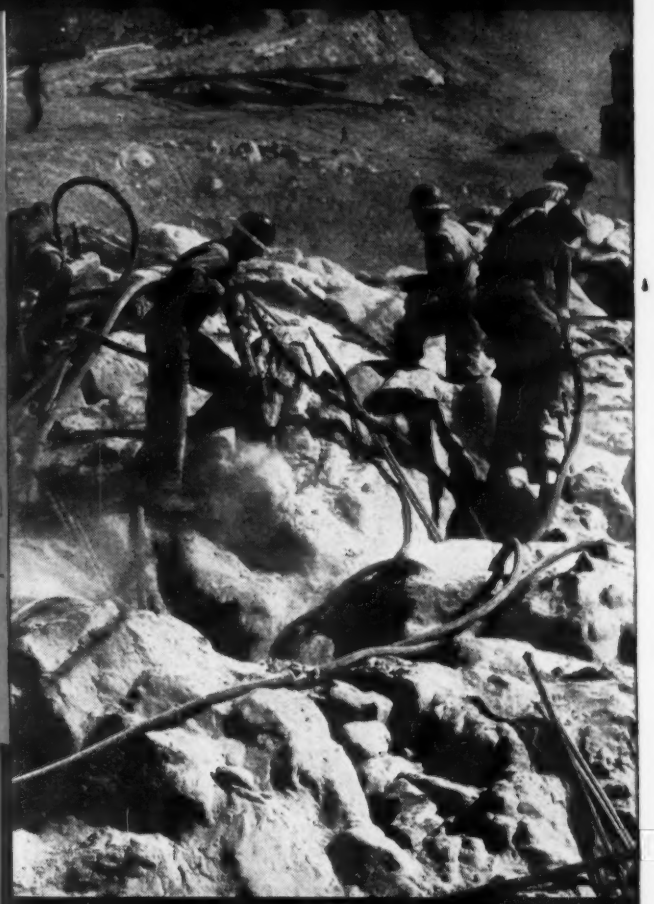
BURKE A.C. & D.C. Motors & Generators

BURKE ELECTRIC COMPANY, ERIE, PENNSYLVANIA • *Since 1891*

Thermoid —For Progress in Many American Industries



In 1870, before the introduction of labor-saving, time-saving, modern equipment, excavation work was tedious and slow.



A modern jack-hammer crew gets things done in a hurry with Thermoid Air Hose.

YOUR business may never use air hose. Nevertheless, it should interest you to know that Thermoid has developed air hose that stands up better against heat and oil . . . to pulsating pressure . . . to cuts and bruises . . . to the abrasion of being dragged over jagged rocks.

Thermoid's leadership in producing superior air hose is typical of Thermoid's leadership since 1880, in the design and manufacture of *all kinds* of hose and belting for power transmission and materials handling. Consultation with a Thermoid representative may develop ways to help you improve processes and reduce costs. *It's good business to do business with Thermoid.*

THE THERMOID LINE INCLUDES: Transmission Belting • F.H.P. and Multiple V-Belts and Drives • Conveyor Belting • Elevator Belting • Wrapped and Molded Hose • Sheet Packings • Industrial Brake Linings and Friction Products • Molded Hard Rubber and Plastic Products.

Thermoid Rubber

DIVISION OF THERMOID COMPANY

TRENTON 6, NEW JERSEY

Contributor to Industrial Advancement Since 1880

what's your need in SIZE?

Globe supplies seamless and welded stainless steel tubing ranging from an outside diameter less than that of an average lead pencil — ⅛ inch — up to 6 inch outside diameter (Iron Pipe Size).

Thick-walled, seamless pressure tubes in carbon and alloy steels from ½ inch up to 6⅝ inch outside diameter for huge boilers in utility and industrial power plants are supplied by Globe, as well.

Your tubing needs may lie somewhere between these two extremes — whatever your requirements, standard or special in a wide range of sizes, shapes, and analyses, Globe is qualified by experience and facilities to supply you with tubing of the quality and uniformity you demand.

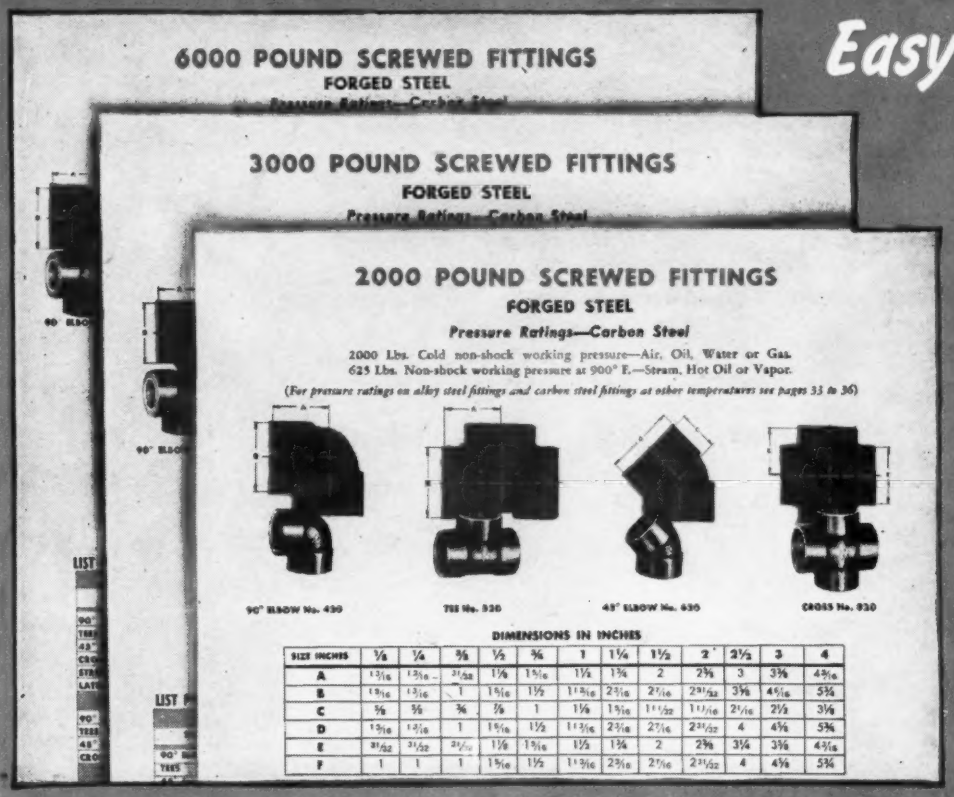
GLOBE STEEL TUBES CO., Milwaukee 4, Wisconsin

GLOBE TUBES

★ STAINLESS STEEL TUBES ★ PRESSURE TUBES ★ GLOBEIRON TUBING ★ GLOWELD TUBES
★ CONDENSER AND HEAT EXCHANGER TUBES ★ MECHANICAL TUBING

5025

A complete line of Screw End Fittings... + Easy Assembly



6000 POUND SCREWED FITTINGS
FORGED STEEL
Pressure Ratings—Carbon Steel

3000 POUND SCREWED FITTINGS
FORGED STEEL
Pressure Ratings—Carbon Steel

2000 POUND SCREWED FITTINGS
FORGED STEEL
Pressure Ratings—Carbon Steel

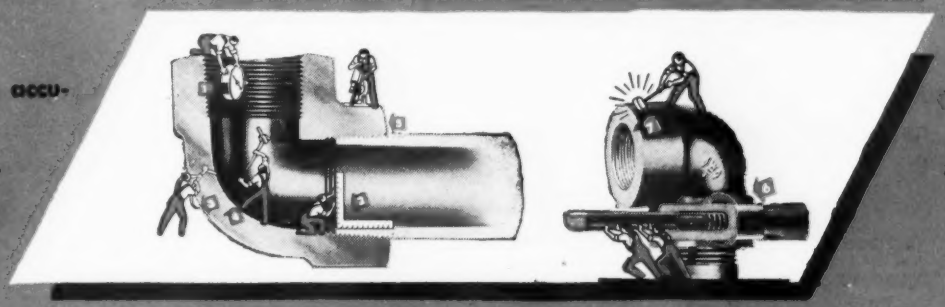
2000 Lbs. Cold non-shock working pressure—Air, Oil, Water or Gas.
625 Lbs. Non-shock working pressure at 900° F.—Steam, Hot Oil or Vapor.

(For pressure ratings on alloy steel fittings and carbon steel fittings at other temperatures see pages 33 to 36)

90° ELBOW No. 930 — TEE No. 920 — 45° ELBOW No. 935 — CROSS No. 920

DIMENSIONS IN INCHES

SIZE INCHES	⅛	¼	⅜	½	¾	1	1¼	1½	2	2½	3	4
A	13/16	13/16	31/32	1⅛	1 5/16	1½	1¾	2	2⅝	3	3⅜	4 3/16
B	1 5/16	1 5/16	1	1 5/16	1½	1 11/16	2 5/16	2 7/16	2 31/32	3⅜	4 5/16	5⅜
C	⅝	⅝	⅝	⅝	1	1⅛	1 5/16	1 11/32	1 13/16	2 1/16	2½	3⅛
D	1 3/16	1 3/16	1	1 5/16	1½	1 13/16	2 5/16	2 7/16	2 31/32	4	4⅛	5⅜
E	31/32	31/32	31/32	1⅛	1 5/16	1½	1¾	2	2⅝	3¼	3⅝	4 5/16
F	1	1	1	1 5/16	1½	1 13/16	2 5/16	2 7/16	2 31/32	4	4⅛	5⅜



1. Threads are long, accurately cut.
2. Perfect alignment.
3. Uniform wall thickness.
4. Unrestricted flow.
5. Controlled chemical and physical properties.
6. Long low bands afford better wrench grip.
7. Rugged — bored from solid drop forgings.

WATSON-STILLMAN Fittings are especially recommended for use on high pressure hydraulic lines and for high pressure, gas, steam and ammonia service.

Elbows, Tees, Laterals and Unions are machined from solid forged steel billets. The materials used for forging stocks are carefully selected for toughness, strength and resistance to temperature and shock.

Threads are long, accurately cut and perfectly aligned to insure tight, leak proof joints. All fittings are chamfered to afford easy assembly.

Sold through leading distributors everywhere.
Watson-Stillman Co., Roselle, New Jersey.

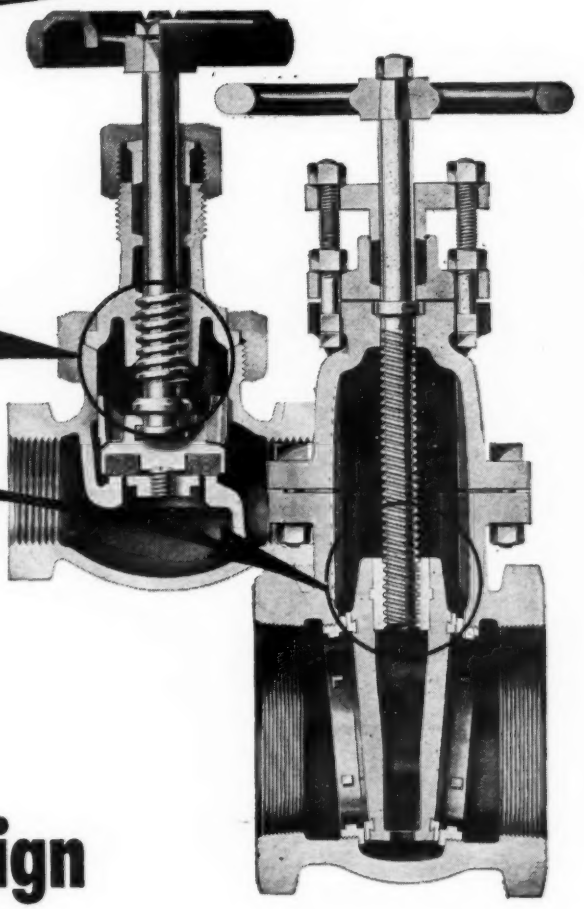
WATSON-STILLMAN
DISTRIBUTOR PRODUCTS DIVISION

Sold Through Leading Distributors

Trifles make perfection but perfection is no trifle

One of a series of advertisements explaining how Kennedy gives careful attention to the details of valve design, construction and workmanship that provide maximum effectiveness, convenience, and length of service.

Contact



..one of the many *surfaces* "strong ~~points~~" in KENNEDY VALVE design

It is customary to speak of an advantageous feature as being a "strong point". But the contact between the stem threads and bonnets or discs of Kennedy Valves is far more than a *point* of strength... it is a *surface* of strength... made so by the unusually large number of heavily proportioned contact threads.

As a result, stripping of threads is practically impossible . . . another detail of Kennedy design that assures long, satisfying service with minimum maintenance expense of every Kennedy Valve.

Write for the Kennedy Catalog which explains in detail why you are SAFE when you standardize on Kennedy Bronze and Iron Body Valves for every standard requirement.

The Kennedy Valve Mfg. Co., Elmira, New York

THE KENNEDY VALVE MFG. CO.

ELMIRA • NEW YORK

KENNEDY *valves... pipe fittings... fire hydrants*

. . . . NOW YOU CAN HAVE *all the Soft water you want* . . . AT NO EXTRA COST!

Latest design Elgin Water Softener

The Elgin "Double-Check" Softener gives up to 44% more soft water, size for size

AUTHORITIES agree that in far too many plants there is not enough softened water for *all* the uses to which it should profitably be put. In some cases this is because requirements have outgrown water softener output; in other cases the management has not put in a softener of adequate size, either because of the space required for a larger unit or because of the greater initial and operating cost of a larger softener.

But whatever the objection it has no standing now. An Elgin "Double-Check" Softener no larger than a water softener of ordinary design will deliver up to 44% more soft water—and deliver it at far lower cost.

The reason for this higher capacity and efficiency is quite simple. The Elgin accommodates a far greater quantity of zeolite and uses it more effectively. It accommodates more zeolite because an ingenious "Double-Check" manifold system prevents the escape of zeolite and therefore permits the use of a far deeper zeolite bed. It uses the zeolite more effectively because a higher backwashing rate is made possible by preventing zeolite loss. This keeps the bed clean and active so that more "zero-soft" water is produced per pound of salt used. As is well known, a deeper zeolite bed gives far greater water softening efficiency.

*** Existing softeners, regardless of make, can be modernized by Elgin to incorporate the features and advantages of the Elgin "Double-Check" Softener.**

Too often the use of soft water begins and ends in the boiler room. But the extra amount of soft water that costs so little more in the big-output Elgin "Double-Check" Softener permits many uses of soft water that are highly profitable through cutting labor costs, improving processes and reducing maintenance costs. Throughout the hot water system, zero-soft water eliminates scale and lime deposits in tanks, heaters and piping, cutting plumbing costs. In all plant cleaning operations it does a better, faster job with a big saving of soap and cleaning compounds. In many plant processes Elgin zero-soft water improves the quality of finished products and where jacketed equipment is involved it increases operating efficiency and cuts maintenance cost.

Ask for this New Bulletin

. . . DESCRIBING THE OPERATION AND CONSTRUCTION OF THIS REVOLUTIONARY WATER SOFTENER.*

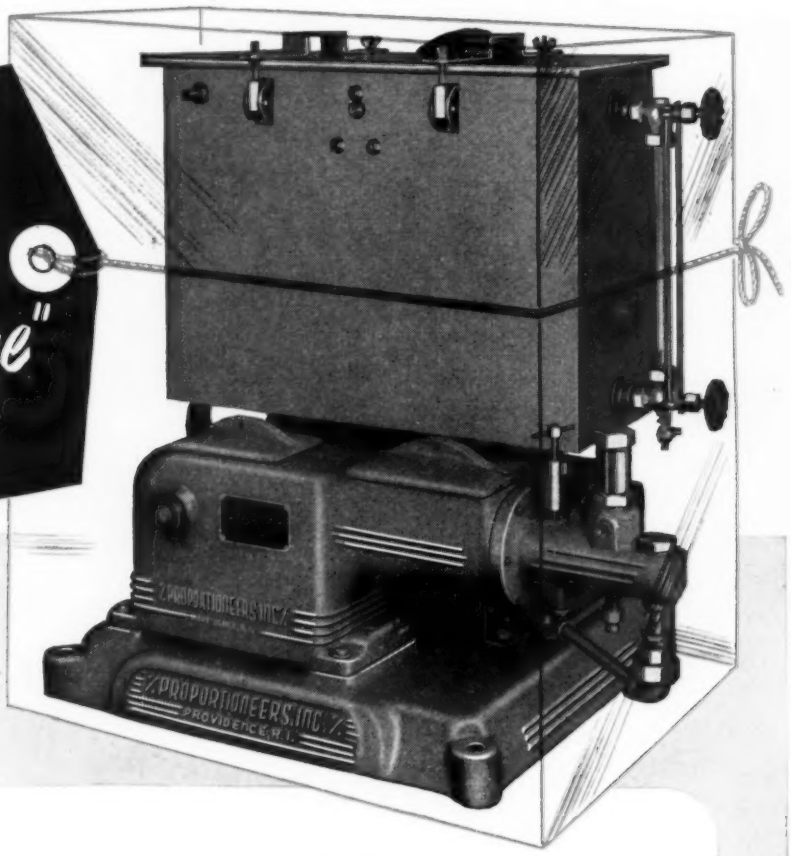
ELGIN SOFTENER CORPORATION

130 NORTH GROVE AVE., ELGIN, ILLINOIS

SOFTENERS ★ FILTERS ★ WATER TREATMENT ★ BOILER WATER CONDITIONING

ATTENTION! POWER PLANT OPERATING ENGINEERS

BOILER WATER TREATMENT "in a Package"



AUTOMATIC EQUIPMENT
TO PREVENT SCALE, PITTING AND CORROSION

Now — for the first time — a true packaged unit is available for boiler water treatment! Here in one unit . . . on one base . . . is a %Proportioneers% Adjust-O-Feeder, with chemical tank and agitator, ready to install. Here is the boiler water conditioning system which eliminates guesswork and assures accurate treatment — automatically feeds all treating chemicals and compounds.

This new packaged unit is the result of over a decade's plant experience in boiler water conditioning and offers those features proved most successful in hundreds of plants.

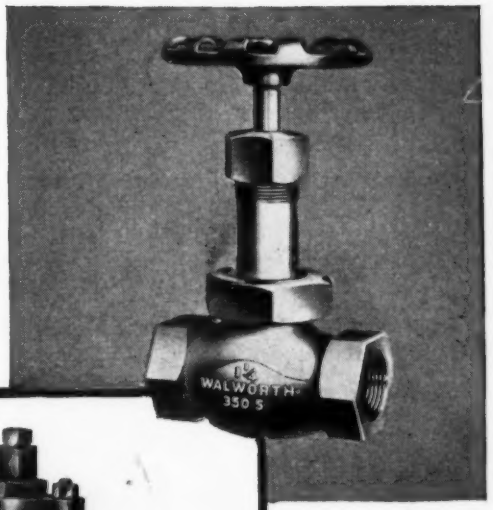
Safeguard your boiler investment . . . improve heat transmission . . . reduce costly shutdowns for repairs and cleaning. Write for information and Bulletin 1714.

% PROPORTIONEERS, INC. %

Write to %Proportioneers, Inc.%, 16 Codding St., Providence 1, Rhode Island
Technical service representatives in principal cities of the United States, Canada and Mexico.

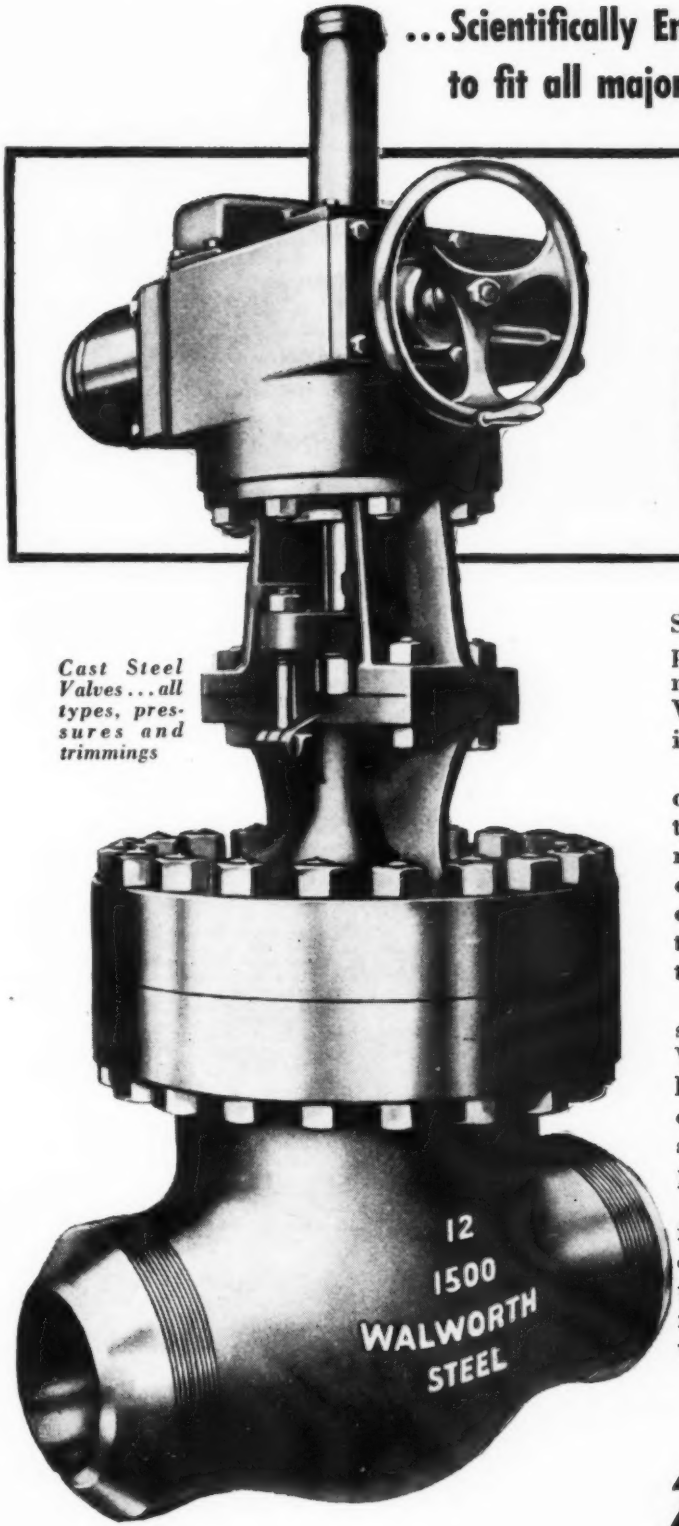
WALWORTH VALVES

...Scientifically Engineered to fit all major services



Bronze Valves ... all types; all pressures

Lubricated Plug Valves ... all metals and pressures



Cast Steel Valves ... all types, pressures and trimmings

Since 1842, Walworth has manufactured valves for every piping requirement ... scientifically engineered to assure maximum economy and worry-free performance. Each Walworth Valve has all the characteristics required for its special service.

For example, Walworth makes a complete line of cast steel valves. They come in gate, globe, and angle types with weld ends, screw ends, or flange ends. Heavy, rugged walls give enduring strength. Deep stuffing boxes eliminate troublesome leakage. Streamlined ports decrease pressure drop. You don't have to be an "expert" to recognize the fact these Walworth valves have what it takes to lick your toughest jobs.

For acids, alkalis, condensates, organic solvents, slimes, slurries — and vacuum the answer is found in a Walworth lubricated plug valve. It opens or closes with but ¼ turn of the valve handle, and a positive tight shut-off is assured. It's easy to operate and remains completely sealed against leakage in both the open and closed position.

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For full information on Walworth's complete line of quality valves get in touch with your Walworth distributor, or write for a free copy of Catalog 42.

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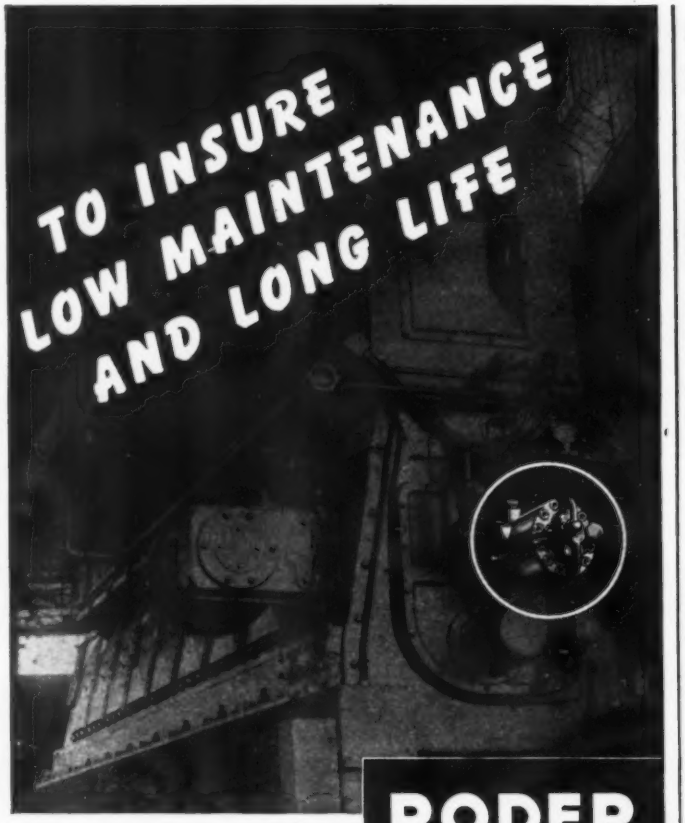

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Like other Roper pumps, it is engineered for a specific job.

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Roper Pumps are designed for easy installation, meeting practically all mounting requirements. Pressures up to 1000 p.s.i., capacities ¾ to 300 g.p.m. at speeds up to 1800 r.p.m.

FLANGE MOUNTING

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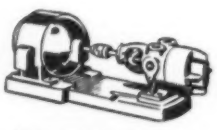

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Service and Engineering Offices in Principal Cities

LUBE OIL PRESSURE PUMP

Here is another Roper application on an 8 cylinder 500 H.P. Superior Diesel converted to natural gas operation. As a lube oil pressure pump, its unfailing performance and smooth positive action is vital to low maintenance and long engine life.

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Similar to other Roper applications, this compact direct drive pump was engineered for easy mounting and dependable operating results. It's typical of Roper ability to adapt pumps that help you save time and money.

Whatever your rotary pumping problems are, write for details and catalog.

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Builders of Pumps for Manufacturing, Marine, Petroleum, Process Industries.

ROPER
Rotary Pumps

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maintenance problems

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When scores of plants were operating at full-time war production, Fiberglas Insulation Materials provided "extra" protection to overcome conditions which caused most motor burnouts and failures—heat, moisture, corrosive vapors or acids, overload and the human element. One company was operating twenty-five variable speed motors which were subjected to heavy overloads under conditions of high ambient heat, high humidity. The average life of these motors, ranging from 2½ to 10 hp. had been about four weeks. Fiberglas-Base Insulation Materials were specified—the service life of these motors was lengthened many times—and "the heat was off" the motor maintenance problem in this plant.

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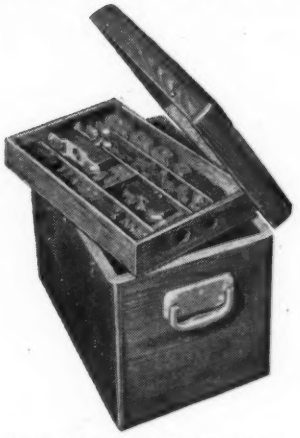
THE PROBLEM WAS THIS: "These valves have a very flexible construction and have an inserted cast machined stainless steel seat. In machining this seat and inserting it in the valve body we found in numerous cases a slight distortion of the circular seat surface because of that flexibility, so that it became necessary to reseat these valves after assembly."

HERE'S HOW LOMBARD SOLVED IT:

"The adjustable cutter bars which we purchased from you have been used exclusively on — 3", 4" and 5" angle and globe valve work. We have used your carbide tipped cutters in these bars and found from our experience that they have given us excellent service. During the time in which these adjustable cutter bars with carbide tipped cutters have been in use . . . the bar used on 3" valves gave us approximately 400 cuttings per grind, and the bar used on 5" valves gave approximately 500 cuttings per grind. Approximately 1/32" in depth and width of material was removed during each valve seat cutting.

"The service that we have been able to get from the reseating machine and adjustable cutter bars has been excellent and has assisted our production immeasurably."



Power Plants and Industries all over America have found in Dexter Valve Reseating Machines and Cutters the way to better valve performance through inexpensive, easy reseating *right on the line.* One man does the whole job in a few minutes time with a Dexter outfit.
Write for full information — no obligation.

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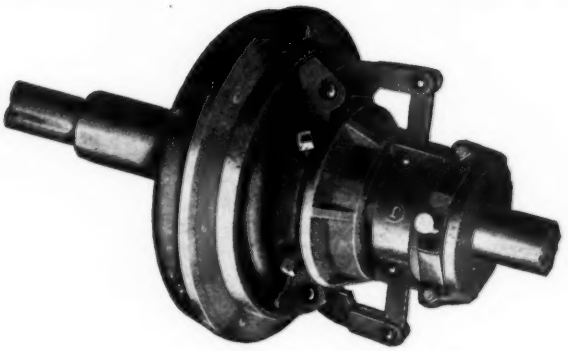
JONES-LEMLEY FRICTION CLUTCHES



JONES-LEMLEY friction clutches are built for a broad range of shaft sizes and ratings in both enclosed and open types for sleeve and coupling work. In addition they are available in a line of Jones-Lemley friction clutch pulleys. This clutch modification is also used for gears, V-belt sheaves, sprocket wheels, etc. Sizes, ratings, dimensions, prices and other data are contained in Bulletin No. 60. Your request will bring a copy.

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FOR EVERY SERVICE CONDITION...

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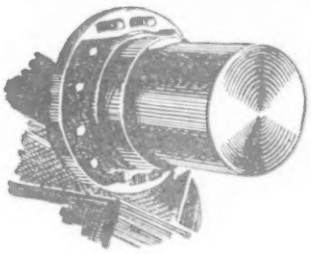
TYCOL "ENGINEERED LUBRICATION"



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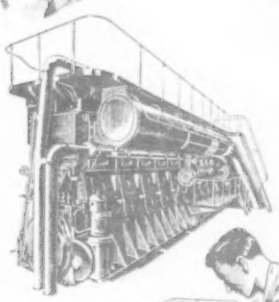

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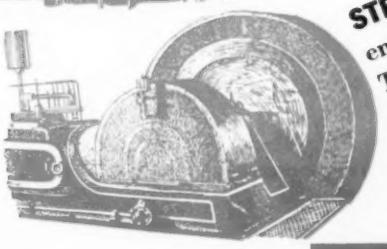

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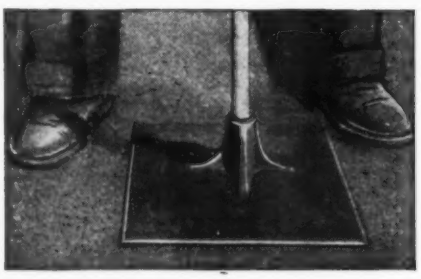

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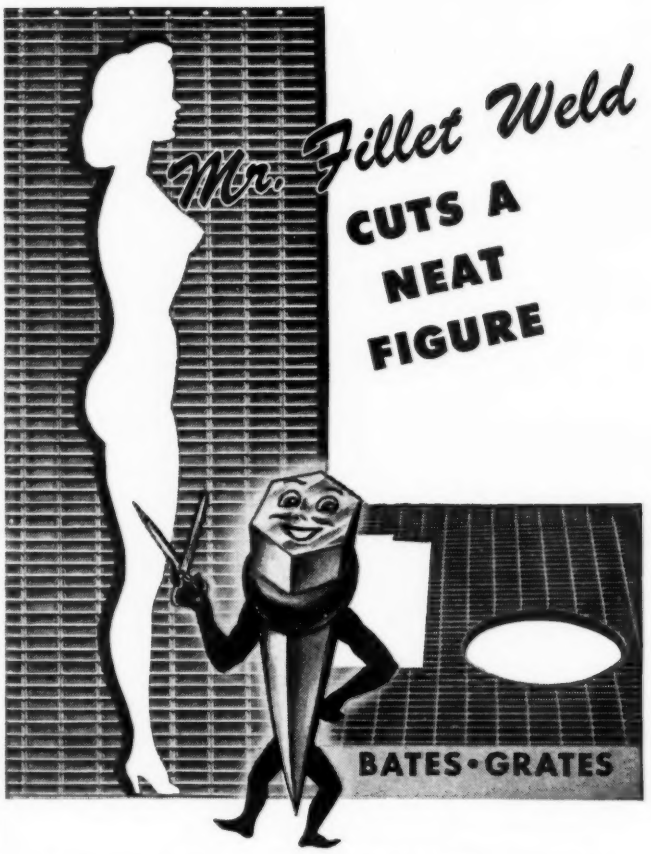

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The fillet welded design permits quick, easy cutting at any point, without reducing the cohesiveness of the floor area.

This is in addition to the extra strength, safety, and economy made possible by the Fillet Welded, Hex Cross bar design of **BATES • GRATES.**

for open steel flooring, stair treads, floor armor and bridge decking . . .

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SAYS THE PLANT ENGINEER . . .

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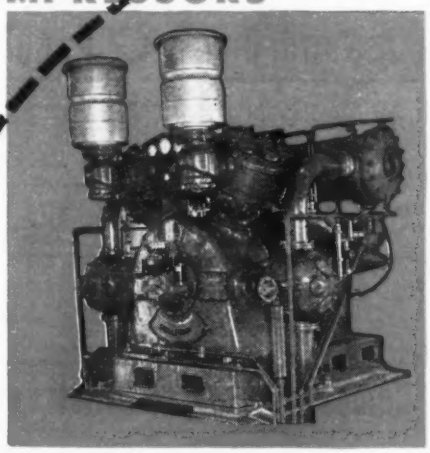
1. By using the material received I was able to get approval for the purchase of a new, completely modern compressed air plant.

2. The Sullivan WN-114 that I bought required so little attention that I was given additional supervisory duties and more responsibility.

3. The management now has a much better understanding of me and my job.

SULLIVAN *100 Series* AIR COMPRESSORS



Sullivan, 100 Series, packaged, air-power plants are two-stage, double-acting, heavy-duty, continuous service compressors — much smaller than old style, bulky compressors of the same capacity — yet have operating economies exceeding those of the older units.

100 Series Compressors need only to be hooked up to power, water and air lines and they are ready for 24-hour per day constant and efficient service. They are particularly suitable for synchronous motor drive and extremely well adapted for drive from steam turbines or diesel engines. Offered in single and twin units with piston displacements from 378 C.F.M. to 3656 C.F.M. at pressures up to 125 p.s.i.

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SULLIVAN

THE WORLD'S FINEST AIR COMPRESSORS FROM ¼ TO 3,000 H. P.

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OR PLEASE WRITE ON COMPANY LETTERHEAD GIVING YOUR TITLE

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ADDRESS_____ **CITY**_____ **STATE**_____

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No. 2 in a series of advertisements on the requirements for the COMPLETE conditioning of boiler water.

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4. Competent Service & Instruction

(to be discussed in the May issue)

THE PRIMARY FUNCTIONS OF SOUND CHEMICAL TREATMENT ARE:

To convert the scale-forming materials in the feedwater to substances less likely to form scale in the boiler. To prevent corrosion due to dissolved oxygen and acidity. To provide inhibitors against "caustic embrittlement."

but — the finest chemical treatment is only ONE of the four requirements for COMPLETE boiler-water treatment.

Incomplete boiler-water treatment can be VERY costly... if you have any doubt as to whether or not your system of boiler-water treatment is COMPLETE, talk it over with the DREW Man — there's no obligation!

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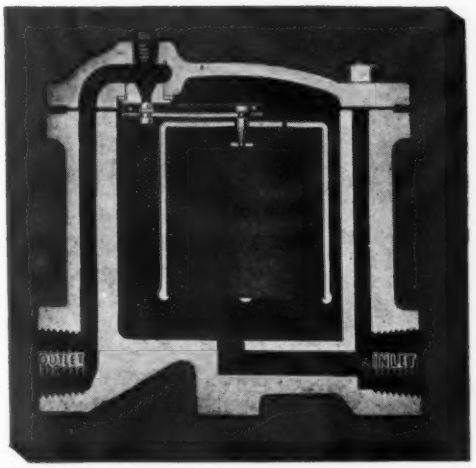
THE *COMPLETE* BOILER-WATER TREATMENT

AMEROID

Fluid Controls made and backed by Clark have been used in practically every industry for more than 37 years and have always met or exceeded claims made for them. Now sold under the Clark name, they are adding to their reputation for savings and improved efficiency wherever steam, air or gas are used.



The popular **CLARK SERIES 70** Inverted Bucket Type Steam Trap with Clark patented Bucket Venting Device and other exclusive Clark features. For general drainage service. Available in 3 sizes: ½", ¾" and 1". For pressures up to 200 P. S. I. and temperatures up to 400° F. Write for free catalog for complete specifications and applications of the wide line of Clark Fluid Controls.

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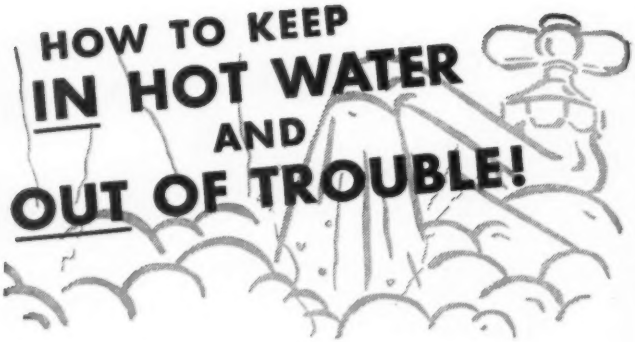
Makers of a wide line of fluid controls including Steam and Fluid Traps • Vacuum and Lifting Traps • Pressure Regulators • Valves • Reducing Valves • Strainers

HOW TO KEEP IN HOT WATER AND OUT OF TROUBLE!



● Where it's essential to keep a steady supply of hot water, install the MARION GULF STREAM HOT WATER HEATER. Indispensable to hotels, office and apartment buildings, large institutions, and factories of all kinds where abundant hot water is essential and steam is available.

Construction is simple. Water is heated faster through intimate contact with steam chambers adjoining. Internal parts float independently, avoiding strain from rapid contraction and expansion.

Low pressure steam is utilized with greatest economy. Inexpensive investment. Capacities range from 370 to 3700 GPH. Instantaneous type but can be used with storage tank.

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Only an INSIDE view of the CASH-ACME Type "B" can show you the many tested and approved features that have contributed to its popular acceptance by Industrial Designers and Maintenance men.

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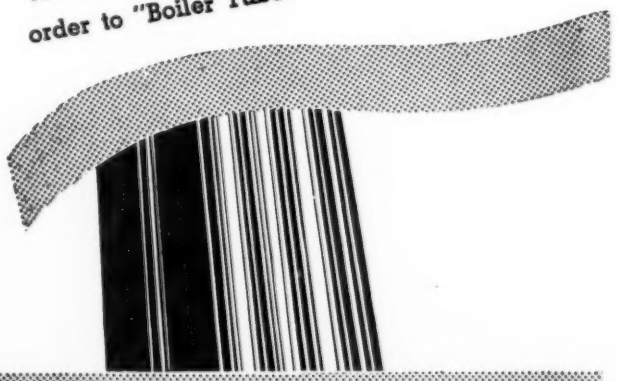
ANY SIZE—BENT OR STRAIGHT

This organization has the experience and facilities to meet your most exacting requirements. We can promise quick delivery on precision work, guaranteeing accuracy as to length and bend. Why not send that next order to "Boiler Tube?"



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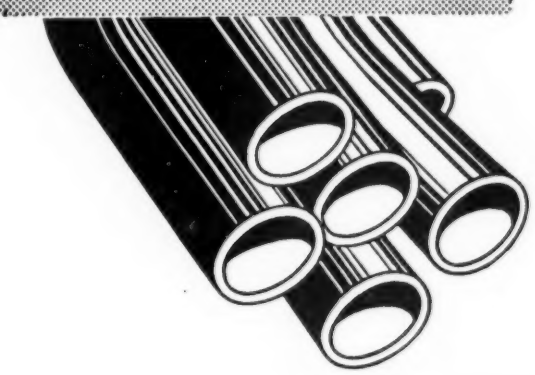

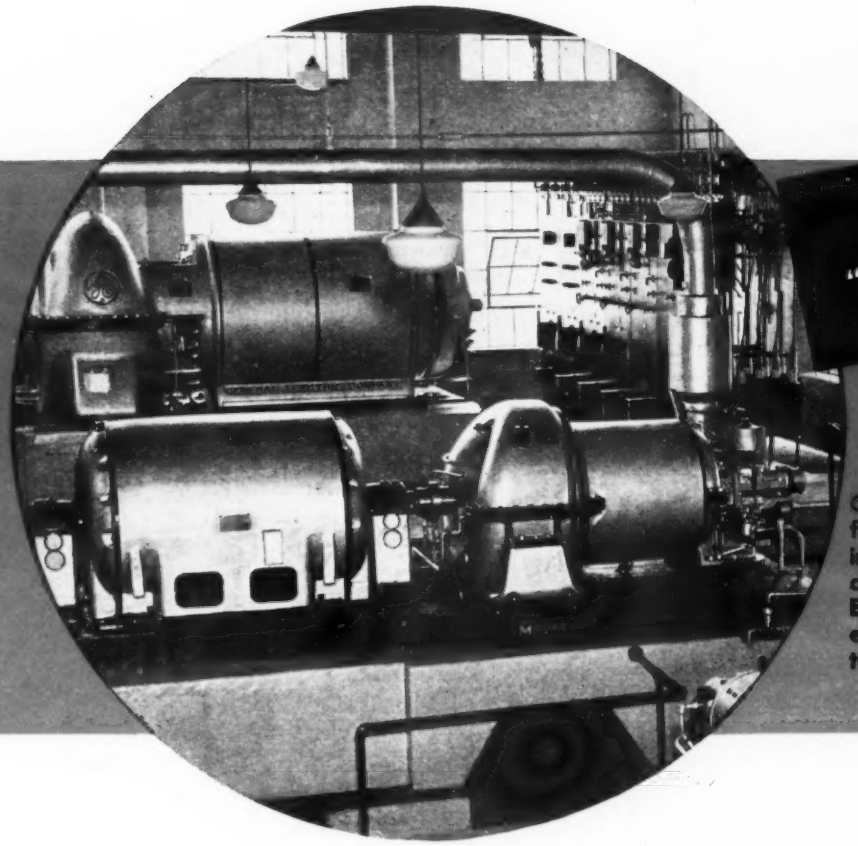

PAGE 8
"PRESCRIPTION NOTE BOOK"

ONE OF A SERIES of data sheets for power plant engineers outlining various Oakite maintenance and equipment cleaning tasks. Each sheet may be filed for reference to serve as a reminder for obtaining more specific information.

Sleek, Bright, *Clean* Painted Surfaces Reflect Your Equipment Efficiency

It is axiomatic that equipment which looks like new generally runs like new. Select a plant where the painted surfaces of generators, motors and turbines and other equipment are kept clean and bright looking, and you will invariably find that such equipment is operating at peak efficiency.

For a low-cost, safe method of cleaning painted surfaces, apply a solution of Oakite Renovator as directed. Safe to use, this material does not harm paint, lacquer or synthetic enamel finish. Nor does it affect the color. Surfaces are left thoroughly clean ... their original gloss and finish are fully restored.

Further details and complete directions are given in the Oakite Power Plant Digest. You will also find this manual helpful in speeding up and simplifying all your maintenance cleaning. When writing for your copy, ask for NEW third edition. It is FREE on request. Write for it today!

OAKITE PRODUCTS, INC.
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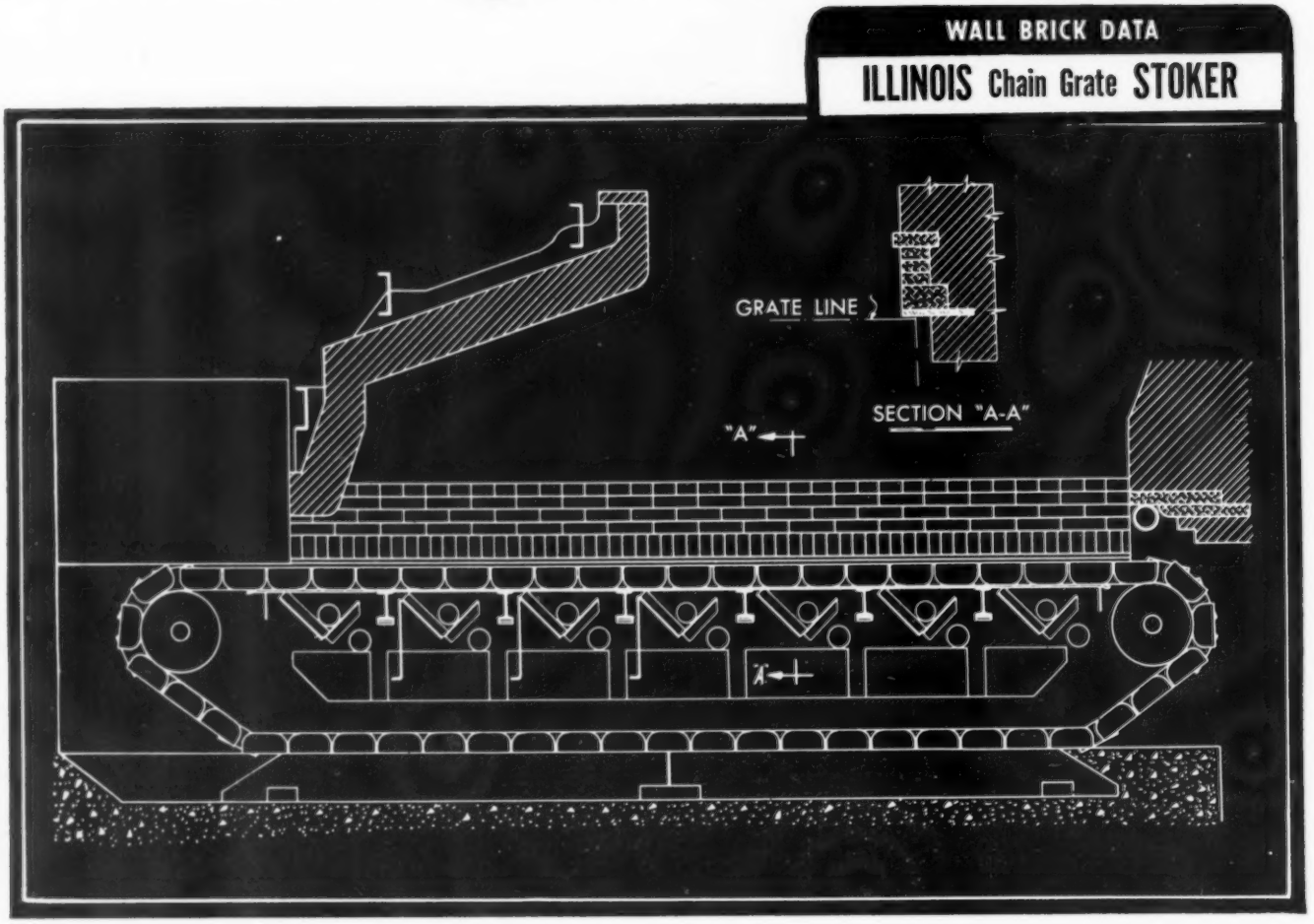
Other Power Plant Cleaning Jobs for OAKITE

Automatic Filters ... Electrical Precipitators ... Controlling Slime and Scale Formation in Air Wash Air Conditioning Units ... Cleaning Evaporative Condenser Coils .... Controlling Slime and Mold in Humidifying Systems ... Cleaning and Descaling Diesel or Gasoline Engines ... Cleaning and Descaling Jacket Water Coolers and Lube Oil Coolers ... Cleaning Surface Condensers ... Cleaning Water and Steam Condensate Meters ... Descaling Water Cooled Compressors ... Cleaning Unit Heaters ... Descaling Ammonia Condensers ... Cleaning Transformers ... Cleaning Painted Surfaces of Equipment ... Stripping Paint ... Cleaning Floors.

OAKITE
Specialized cleaning
MATERIALS & METHODS FOR EVERY CLEANING REQUIREMENT

NOTE: The Oakite Technical Representative in your locality is ready to give you the benefit of his experience and personal help on any power plant cleaning or related problem. This Advisory Service is free.

A Furnace Program that wins approval



Illustrated above is a well engineered installation of CARBOFRAX silicon carbide brick in an Illinois Chain Grate Stoker. The height of the lining may vary with operating conditions, but the use of a CARBOFRAX lining constitutes a program which is bound to win approval.

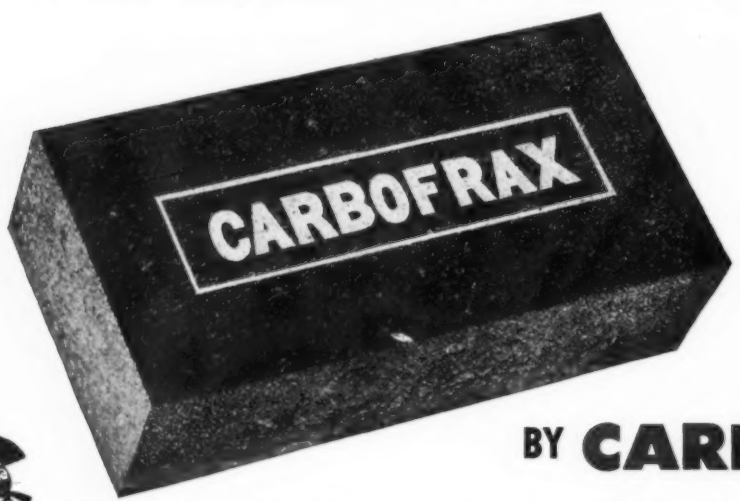
There are countless instances where the life of a CARBOFRAX lining has been carefully investigated and compared. Reports of 10 or more years of service are not unusual. The examination never fails to prove the longer life which a CARBOFRAX lining gives, and the steady punishment it can always take.

With a CARBOFRAX setting you can usually count on greater steaming capacity, too. The super refractory quality of CARBOFRAX brick discourages large clinker formations, and the complete grate area is more apt to be utilized. The long life also contributes to increased production since outages for lining repairs are drastically reduced, compared to the use of ordinary refractories.

The fuel figures also look good when CARBOFRAX linings are used. Combustion is naturally improved when you get a cleaner, more active fire. And that means fuel savings.

CARBOFRAX brick will prove itself in the clinker zone of any stoker or furnace. Their high refractoriness, great strength, and mechanical and flame resistance never fail to show up to operating advantage. Make it a point to investigate their benefits soon.

In the meantime we'll gladly send you a booklet containing complete engineering data on our super refractories, if you write Dept. G-26, The Carborundum Company, Refractories Division, Perth Amboy, New Jersey.



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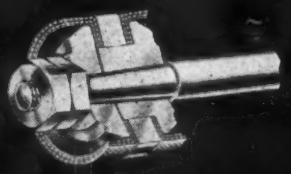
AHEAD OF THE FIELD

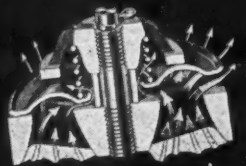
Warren "Realwear" Steam Pumps

WARREN MOLDED PISTON CUP PACKING



THE DURABLA VALVE

Completely open under full load



Partially open under light load

4 new standard features at no extra cost!

Yes, Molded Piston Cup Packing, Stainless Steel Durabla Valves, Stainless Steel Piston Rods and All Steel Valve Gear (Bronze Bushed), are now *standard* features on Warren Horizontal Duplex Piston Pumps—"Realwear" Type! Standardization of these features . . . in addition to the many other advantages of "Realwear" design . . . gives you a pump that is far and away the leader in its field. Here are the advantages:

WARREN MOLDED PISTON CUP PACKING

Greater efficiency and lower operating costs because of minimum slippage . . . and longer liner life because of less wear when these cups are used.

Repacking made easier.

Much longer life of cups compared to ring packing.

Successfully handles practically all liquids . . . including hot water to 250° maximum at pressures to 1000 lbs. maximum . . . with standard cups and higher temperatures and pressures with special cups.

STAINLESS STEEL DURABLA VALVES

Achieve instant adjustment to variations in load; open only enough to allow passage of the flow; close instantly; eliminate slip; reduce cavitation, turbulence, and friction losses to a minimum; and permit pumps to operate at full load at slower speeds.

STAINLESS STEEL PISTON RODS

Insure maximum resistance to corrosion and wear.

ALL-STEEL VALVE GEAR (Bronze Bushed)

Adds strength and length of life to this constantly moving and important part of the pump.

Write for information

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WARREN STEAM PUMP COMPANY, Inc., Warren, Mass.

Use
THE GENUINE
Squires
REDUCING VALVES
for dead - end service, or wherever close regulation is required.

Also Steam and Air Traps, Pump Governors and Boiler Feed Water Controllers.

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EASY MONEY
- in the Northwest

A government hospital in the vicinity of Spokane has found an easy way to make money. Two Brownell stokers installed last July are using only 63 tons of coal a month @ $8.75 for laundry process steam compared with 107 tons a month @ $10.78 previously used with hand firing.

As you can figure, the saving on coal alone amounts to more than $7,000 a year, not counting the reduced labor cost. The stokers are paying an annual dividend of over 100%.

If you're interested in a high-yield investment like that, let the nearest Brownell agent put you wise. Write us in case you don't know who he is.

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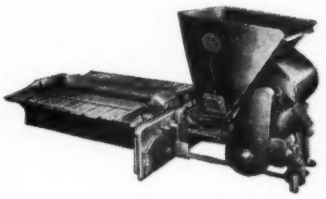


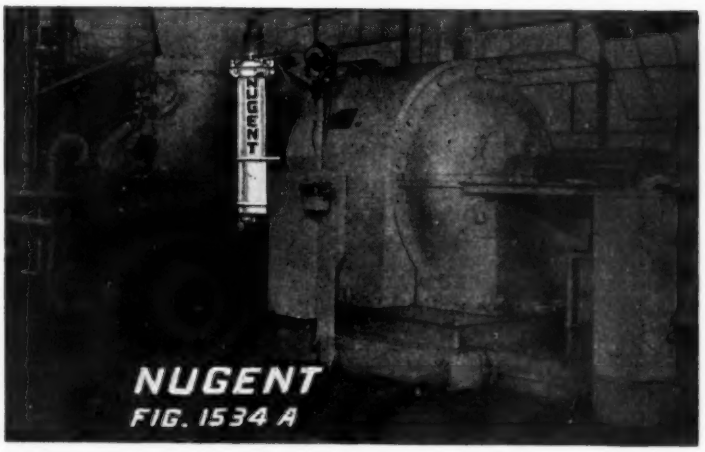
Brownell Ram-Type Underfeed Stoker with Side Dump Grates. Sizes to fit all boilers up to 560 h.p., double retorts to 700 h.p.

Gas Turbines Too... use NUGENT FILTERS

to keep oil cleaner longer
— reduce maintenance
— increase efficiency

YOU can rely on Nugent for efficient oil filters for every industrial application. Here, a Nugent Filter is installed on a gas turbine at the Sun Oil Refinery, Marcus Hook, Pa. This Brown-Boveri turbine has now been in use for four years, and the Nugent Filter is proving its ability to keep the light turbine oil practically 100% clean.

The filter has a capacity of 30 GPM, yet it is only 38" high by 11½" diameter overall. The efficient filter bag is very inexpensive and is easily replaced when it becomes dirty. Nugent's long and practical experience in oil filtering is at your service. When you plan new machinery, ask Nugent about the oil filters.



WRITE FOR BULLETIN 7A

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ESTABLISHED 1897

Fuel Oil Filters • Lube Oil Filters • Lubricating Systems • Sight Flow Indicators • Oiling Devices

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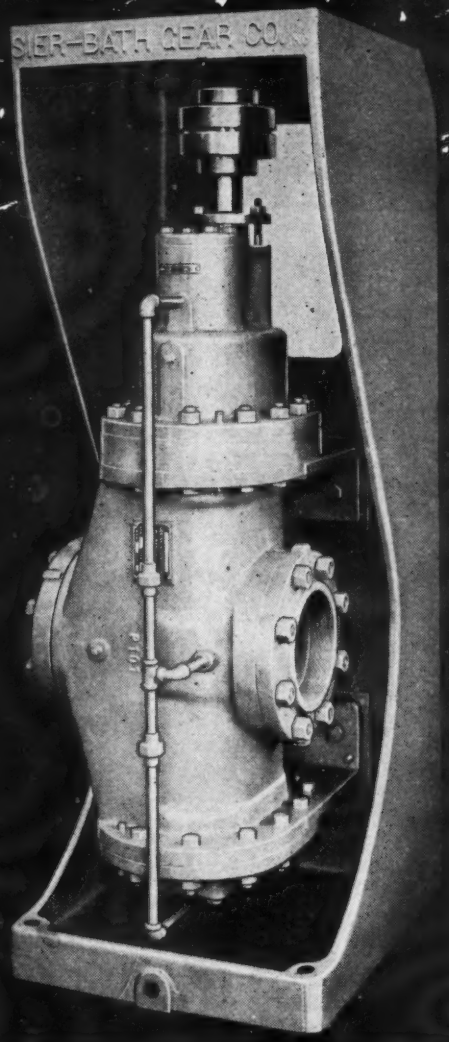
Winter Pumping is Easier with SIER-BATH SCREW PUMPS



SIER-BATH SCREW PUMP Vertical Model
Available also in horizontal model. This unit handles Bunker C Fuel Oil. Rated at 350 g.p.m. 50 p.s.i., 10" vacuum 20 h.p. 1150 r.p.m. motor drive. Built for Y tankers A.S.F.

These pumps eliminate the need of maintaining low fluid viscosities in cold weather. Hence, they reduce heating steam consumption and minimize fluid carbonizing. Sier-Bath Screw Pumps handle highly viscous fluids without pulsation because they apply the tremendous thrust of quadruple screws.

In fuel oil burner service, the Sier-Bath Screw Pump's pulseless discharge produces an even, steady flame that reduces tip carbonizing and promotes boiler efficiency. It does not strain piping as does a battering intermittent delivery. Quiet in operation, Sier-Bath Screw Pumps are higher in efficiency and less affected by head. They need neither heavy foundations nor deep bolting. They have anti-friction roller bearings as standard design and removable liners may be specified. Write for bulletin.

PUMPS Acetates—Asphalts—Brines—Bunker C Fuel Oil—Cellulosics—Molasses—Syrups.

BUILT TO CLOSER TOLERANCES BECAUSE THEY ARE MADE BY ONE OF THE FINEST MACHINE AND GEAR-CUTTING SHOPS IN THE EAST

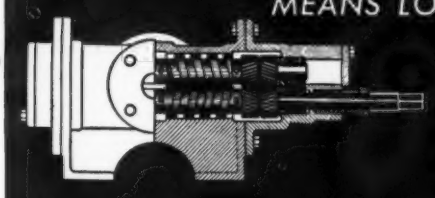
If you need gears—have them made the way Sier-Bath Screw Pumps are made—on modern, precision machinery.

SIER-BATH GEAR COMPANY, INC.
9254 HUDSON BOULEVARD, NORTH BERGEN, NEW JERSEY

Sier-Bath Gear Co. Inc.

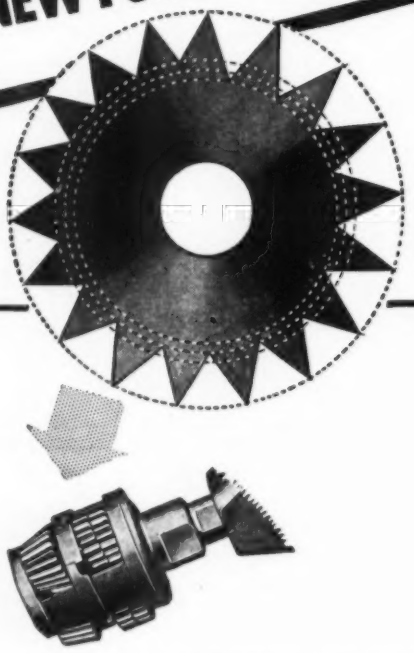
Only Two Moving Parts

MEANS LOW MAINTENANCE



Only an occasional packing is needed and that can be done while pump is running.

AIRETOOL'S NEW FORM CUTTERS



PREVENTS TUBE CLEANER TRACKING STOPS TUBE DAMAGE

The operator of Airetool Tube Cleaners need have no fear of cleaner damaging tubes. That is because the *new form cutters*, used in Airetool Tube Cleaners, eliminate the tendency of the cutter to track. The periphery of the cutter is milled to divide sections of the circumference in teeth of various pitch, which prevents the cutters finding same spot in a tube wall during each revolution—an exclusive Airetool development.

Other Airetool Tube Cleaner features are: A 28% more powerful motor made possible by the Airetool Balanced Rotor and Power Seal, precision construction of finest alloy steels, ease of operation. Made for tubes ½" to 24" I.D.; straight or curved.

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Airetool Tube Expanders are precision tools, made to efficiently and thoroughly perform any tube rolling operation. They are precision built of heat treated alloy steel, with a maximum amount of tortional strength provided in the mandrel to resist the extreme twisting action and another special alloy steel in the roll to resist compression during the rolling operation. Made for tubes ½" to 12" I.D.; straight or curved.

Airetool offers a complete line of equipment for tube maintenance including tube jigs, gauges and calipers.

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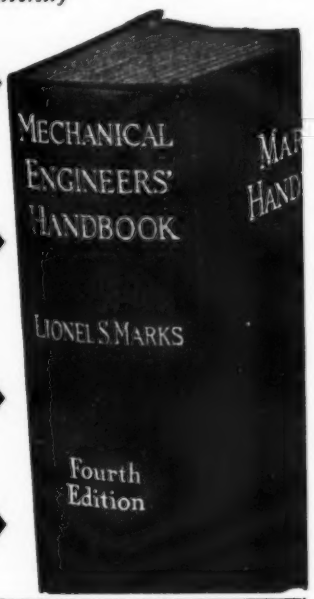

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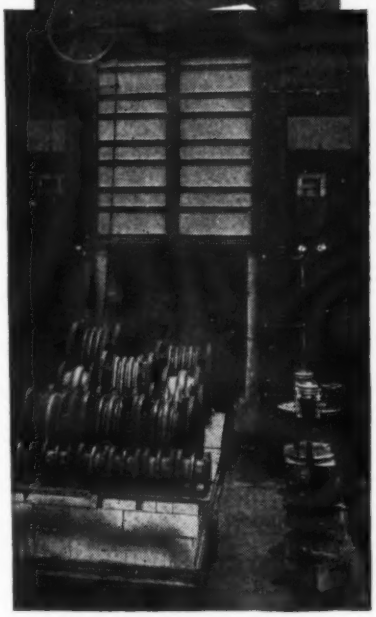
Removing stainless steel corrugated elements from furnace for quenching.



Charging a furnace with copper expansion joints for final anneal.

Zallea Corrugated Expansion Joints are made in non-equalizing, self-equalizing and Duo-equalizing types, depending upon the conditions under which they must operate . . . of copper, stainless steels and other corrosion-resistant alloys . . . diameters from 3" upward . . . traverses up to 7½" . . . for pressures from vacuum to 300 psi . . . for temperatures from sub-zero to 1600° F.

For complete descriptions and specifications write for Bulletin 46 now in preparation, or ask us to quote on your requirements.

why Zallea Corrugated Expansion Joints Endure

During fabrication and after the final forming operation all Zallea Expansion Joints are given a full anneal to remove all stresses left by the forming operation. Proper heat treatment is essential to secure the maximum potential life of any corrugated expansion joint.

Although this heat treatment varies with the metal, in every case the corrugated element must be slowly and uniformly heated to a predetermined temperature, held there for a definite time, then cooled at a definite rate. Obviously, this cannot be accomplished by local annealing with torches—the method most often used in the manufacture of corrugated expansion joints.

All Zallea Expansion Joints are properly heat treated in gas-fired furnaces equipped with temperature controls capable of maintaining temperatures constant within 25° at any point up to 2000° F. Recorders provide a permanent record of each heat.

"Code-Craft"...
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EQUIPMENT FOR THE PROCESS INDUSTRIES
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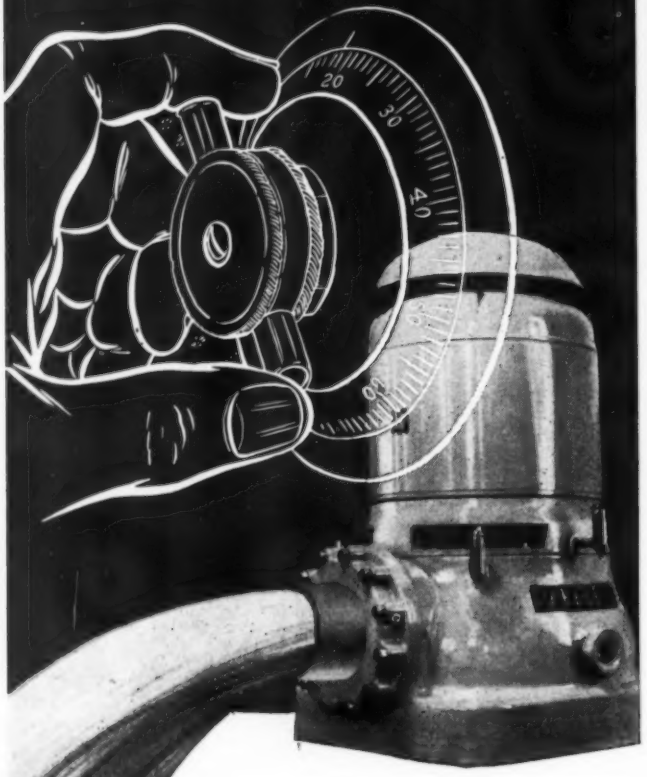
Specify and Demand *Furnace-Annealed* Expansion Joints

The Right Combination
FOR L-O-N-G-E-R PUMP LIFE



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Peerless PERFORMANCE
Peerless FIELD SERVICE

Behind the Peerless combination is safe pumping—the kind of operation that eliminates pump worries for years to come. Peerless Deep Well Turbine Pumps are foremost on the water front because of their traditionally better performance and greater dependability. Capacities: 15 to 30,000 gallons per minute.

Peerless also manufactures a complete line of Domestic Water Systems, and Horizontal Centrifugal Pumps (formerly Dayton-Dowd).

Get in touch with the nearest Peerless distributor right now if you need a new pump during 1946. He has interesting news for you.

PEERLESS PUMPS

PEERLESS PUMP DIVISION
Food Machinery Corp.

FACTORIES
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The Operation was successful but the Patient died

Concentrated effort to overcome one condition—only to have the patient succumb to another—is a bad policy to follow in the case of humans and **BOILERS** *too.*

DOMINION'S PLANNED SERVICE SYSTEM is based on the fact that proper boiler feedwater conditioning requires a careful system of control, which overcomes the trouble-causing elements in the water, and yet does not exert any harmful effects on boiler room equipment.

Our Service Staff is composed of Field and Laboratory Technicians. Coordinating our facilities with your boiler problems, enables us to prescribe a boiler feedwater conditioner, which is designed for *your boiler only.* There is no danger of the "operation being successful—but the patient dying" because DRY PINK—the individual boiler feedwater treatment prepared in our laboratories—is geared to *your* boiler room operations—meant to overcome water problems in *your* locality—and continuous service on our part assures *you* of trouble-free boiler operations.

Write for full details on DOMINION'S PLANNED SERVICE SYSTEM

Dominion CHEMICAL CO., Inc.

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The rugged strength that withstood this elemental fury is engineered into every Marley installation . . . together with many other outstanding features . . . resulting from Marley's years of specialization in exclusive production of water cooling equipment.

MARLEY

COOLING TOWERS

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COMPRESSED AIR LINE PURIFICATION YOUR PROBLEM?

Here's the Answer...

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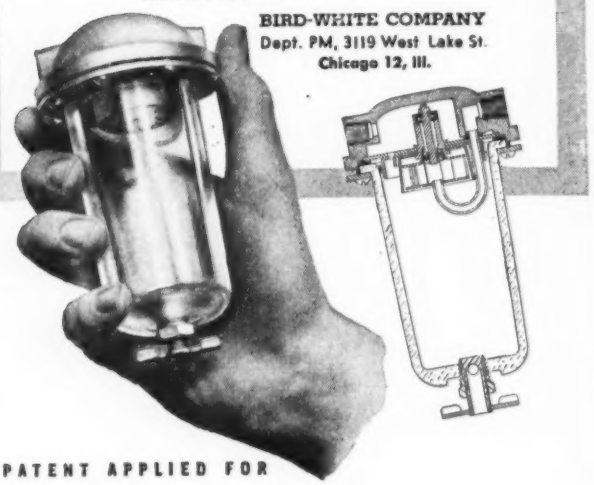

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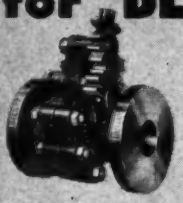

THIS IS THE SEALING VALVE

THIS IS THE BLOWING VALVE

EVERLASTING DUPLEX BOILER BLOW-OFF UNIT, COMPLETE

A "regular" *EVERLASTING* Valve that opens fully with one short movement of the lever . . . a wheel-operated *EVERLASTING* Companion Valve built to take the full punishment of the blow-off . . . these two valves, coupled together, provide a combination that meets full code requirements for dual-valve blow-off.

The lever-operated *EVERLASTING* Valve, designed for unimpeded, straight-through flow, maintains its tight seal, because it re-grinds itself with each operation. It cannot wedge or stick.

The *EVERLASTING* Companion Angle Valve, designed specifically for blow-off service, stoutly resists erosive blow-off water and the abrasive action of solids in such water.

Either valve obtainable separately if desired.

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EV-274

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for everlasting protection

Want More Steam in a hurry?

Put in

FYR-FEEDER MULTIPLE SPREADER STOKERS

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FEATURING:
AIR JET COAL PROPULSION

QUICK FACTS—

- FYR-FEEDER is automatic, modern, high efficiency firing at its best!
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- Easily installed in minimum time. Standard ratings up to 1200 lbs. of coal per hour. IF YOU ARE IN A HURRY WIRE, PHONE, OR WRITE.

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☐ YES! Please send literature. Name_____

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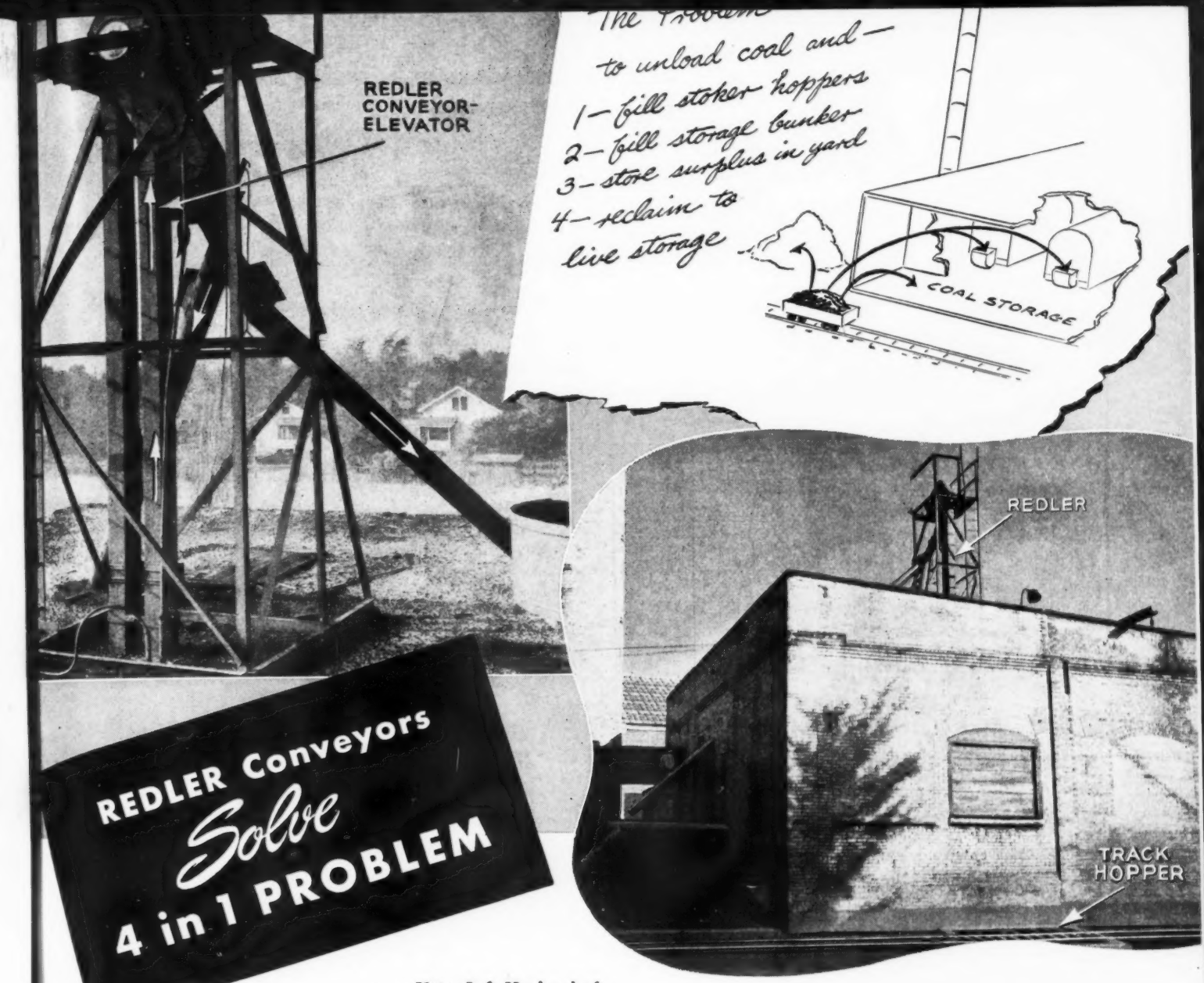
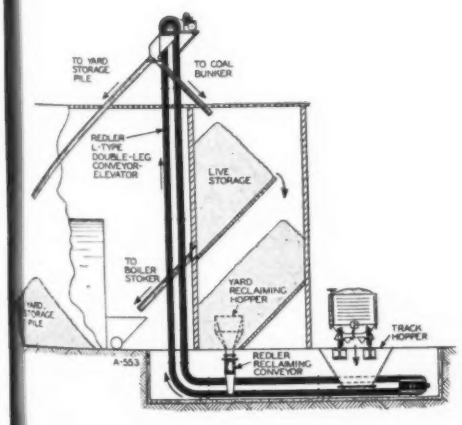


REDLER Conveyors *Solve* 4 in 1 PROBLEM



Upper Left: Head end of REDLER Conveyor-Elevator and 2-way spout which delivers coal to live storage bunker or surplus yard storage.

Upper Right: General view of power plant, showing track hopper, REDLER Conveyor-Elevator, surplus yard storage and hopper to reclaiming REDLER Conveyor.

Left: Diagram showing how the two versatile REDLERS solve the 4 in 1 problem.

Two versatile units—one REDLER Conveyor-Elevator and one REDLER Conveyor—solve the coal handling problem in this small power plant, where four separate coal handling operations were desired.

In action, this practical S-A REDLER System unloads coal direct from cars and distributes: (1) to inside gravity storage above stoker hoppers, (2) to inside surplus storage, (3) to outside yard storage, and (4) reclaims from inside and yard storage to live storage bunker as needed.

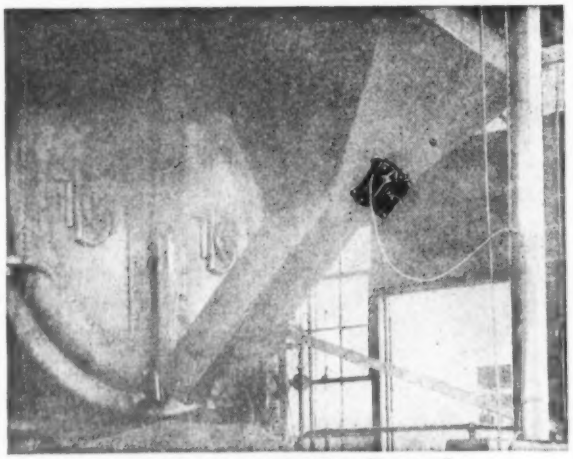
Catalog No. 140 gives engineering details and shows typical installations of REDLER Conveyor-Elevators—the original and most effective mass-movement, sealed casing conveyors.

STEPHEN S-A ADAMSON MFG. CO.

5 RIDGEWAY AVENUE, AURORA, ILLINOIS · LOS ANGELES, CALIF. ★ BELLEVILLE, ONT.

Designers and Manufacturers of All Types of

BULK MATERIAL HANDLING EQUIPMENT



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You enjoy smoother, easier pipe threading with this self-contained semi-automatic . . . . .

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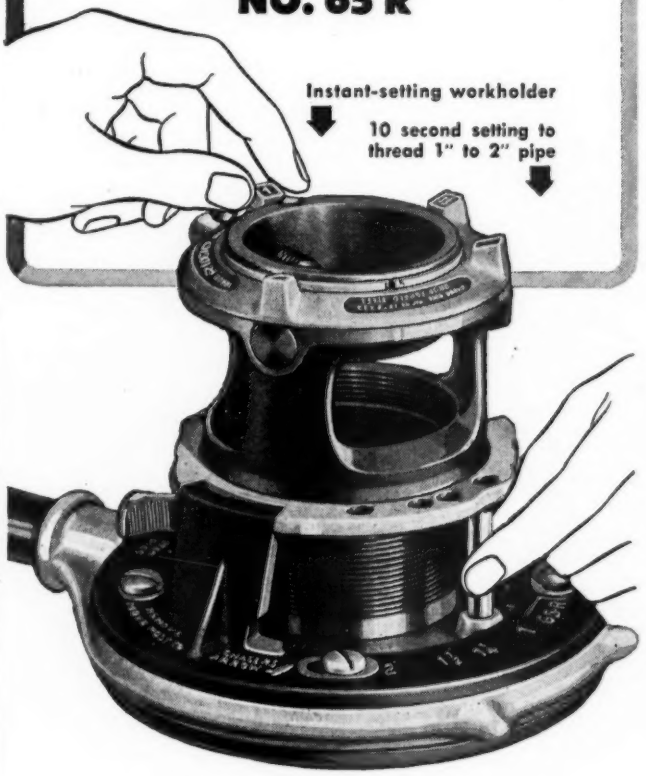
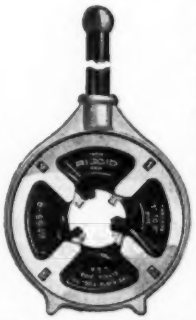
NO. 65 R





It stands up handily on the floor.

● Precision-made and tested in every one of its 23 rugged steel-and-malleable parts, the 65R gives you fast, smooth, almost effortless pipe threading. Clean perfect 1", 1¼", 1½" and 2" threads with one set of high speed steel dies that adjust to size in 10 seconds. Workholder sets to pipe size instantly —1 screw and no bothersome bushings. You enjoy owning and using this modern threader — order from your Supply House.

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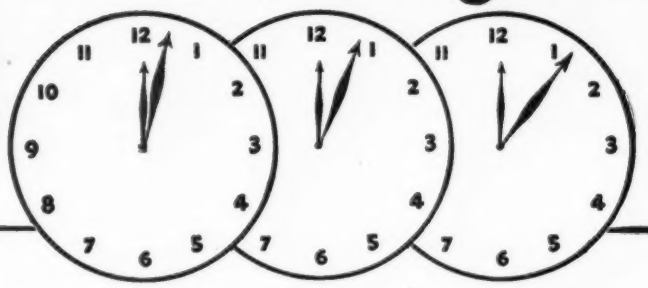

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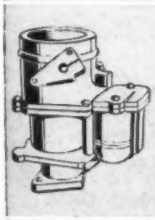
TYPICAL USES FOR Solvent "26"



CARBURETORS—Solvent "26" removes gum, gasolene sediment and other accumulations of dirt.

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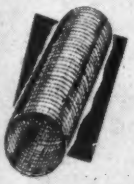

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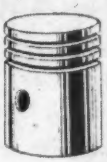
LABORATORY EQUIPMENT—Solvent "26" frees glass and metal tubing and their supports of gums, varnishes and other incrustations or deposits.



PISTONS—Removes lacquers, gums, resins, etc. from gas, gasolene and diesel engine pistons and rings. Also effective for cleaning all parts of dismantled motors, engines and machinery.

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The fast action of Solvent "26" reduces cleaning time from hours to minutes on dismantled engine parts and all kinds of machinery. Simply dip, rub, brush or spray it on. Then flush clean with hot water.

Mail the coupon today for literature and information leading to a demonstration of this unique product in your own plant.

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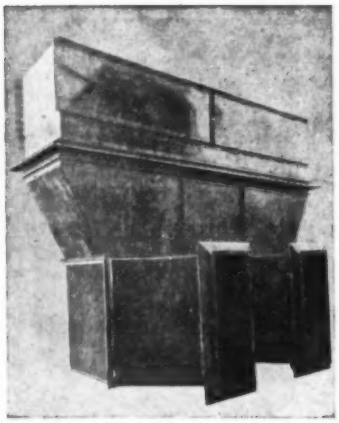

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The oil that creeps and loosens frozen parts. . . . The new chemical that will pass through openings as small as a millionth inch . . . proved by laboratory tests. 3500 industrial concerns are using Kroil regularly to keep production going. Read these case histories.

The Stubborn Spindle:

Spindle of automatic machine froze. 12-ton hydraulic press used to remove bushings—without success. Kroil applied. In 20 minutes part removed with ease.

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Because of frozen pulley shaft, plant officials expected half-day's tie-up in production. Kano Kroil was applied. Production resumed in fifteen minutes.

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$50,000 worth of monotype equipment lying idle while we fussed for 2 days with 12 lousy screws. Soaked the parts in kerosene, light oil and several penetrating oils. Then we used Kroil. "Darn stuff turned rust into mush so we could turn the screws and use the parts again."

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Before trying Kroil we broke off every nut on our heat treat quench trolleys. Since then we have not lost one and have decreased our repairing time from 30 to 6 minutes per trolley.

Try KROIL on a money-back basis. Gallon, $3.00 fob Chicago.

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Simple and rugged in design and constructions

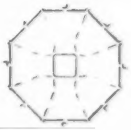
Economical in steam consumption and maintenance

Operation free of objectionable dust

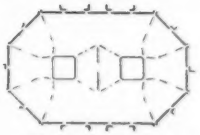
Best layout in every case based on 25 years of experience

Front-View of Side-Discharge or Semi-Octagonal Tank.

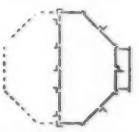
CAST IRON SECTIONAL TANKS, BUNKERS, BINS, HOPPERS and SILOS



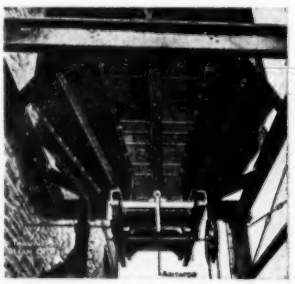
Octagonal



Oblong-Octagonal



Semi-Octagonal



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Durability combined with our exclusive discharge-efficient and self-clearing designs, preventing arching, packing and sponstaneous combustion in case of coal bunkers and also obviating the necessity of hazardous trimming.

MECHANICAL SOOT BLOWERS for FIRE-TUBE BOILERS of ALL TYPES

Complete removal of soot and fly-ash from tubes END TO END.

No waste of steam or air, as there is a fixed nozzle centered to each tube.

No cutting of tube-sheet or tube-heads possible.

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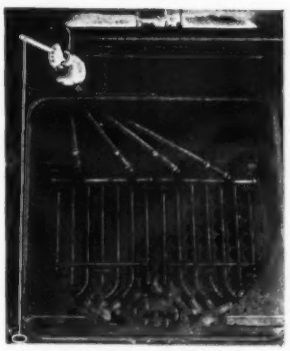

Mechanical Soot Blower with H. R. T. Boiler

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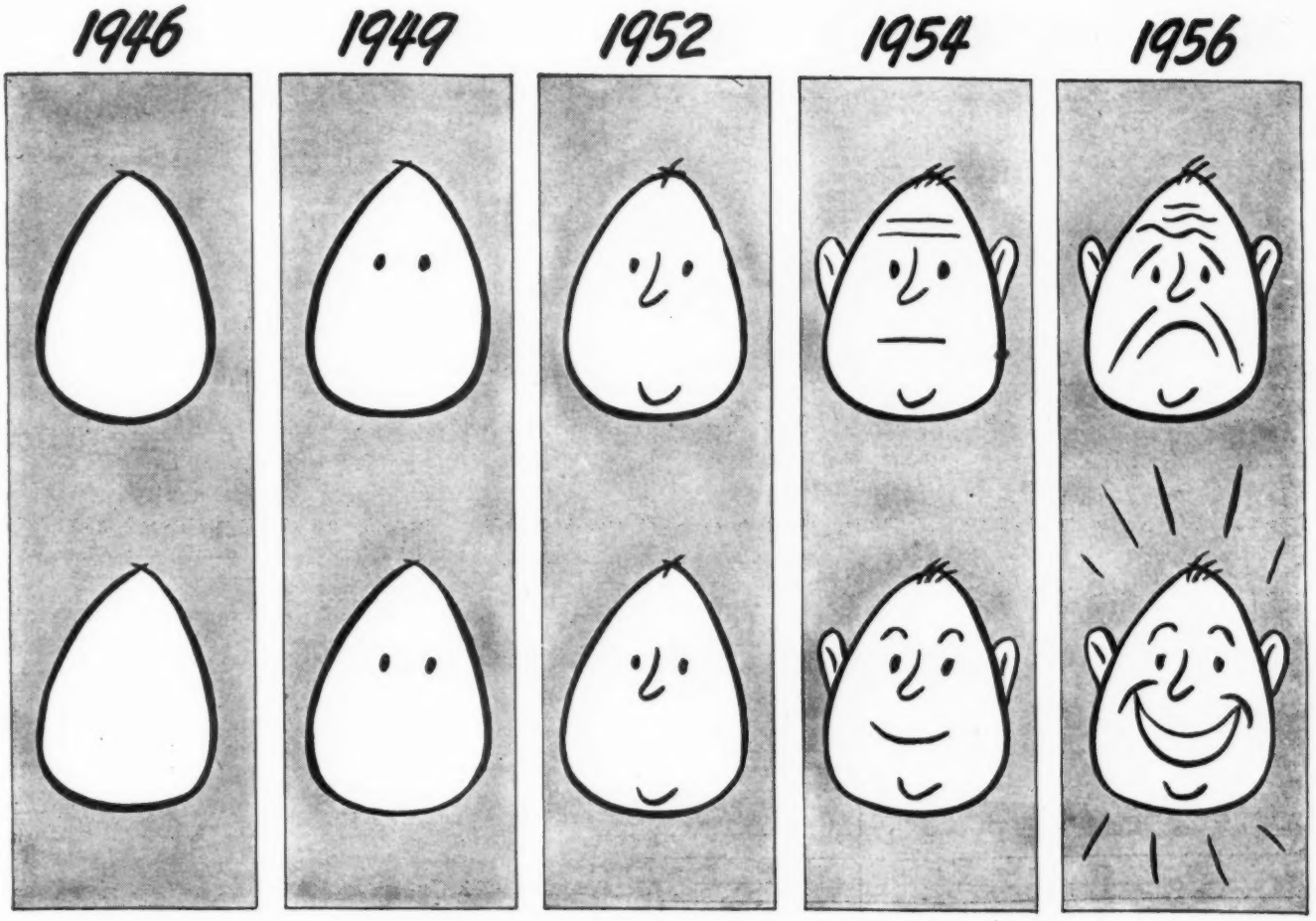

Two ways your face can grow in the next few years

USUALLY, our faces show what's happening to us. For instance, suppose financial matters are constantly on your mind.

Suppose you know that there's practically no cash reserve between you and trouble.

It would be surprising if your face didn't show it.

But suppose that, on the contrary, you've managed to get yourself on a pretty sound financial basis.

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Naturally, your face will show *that*, too.

There's a simple and pretty accurate way to tell which way your face is going to go in the next few years:

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Your face will be among the ones that wear a smile.

Buy all the Bonds you can... keep all the Bonds you buy

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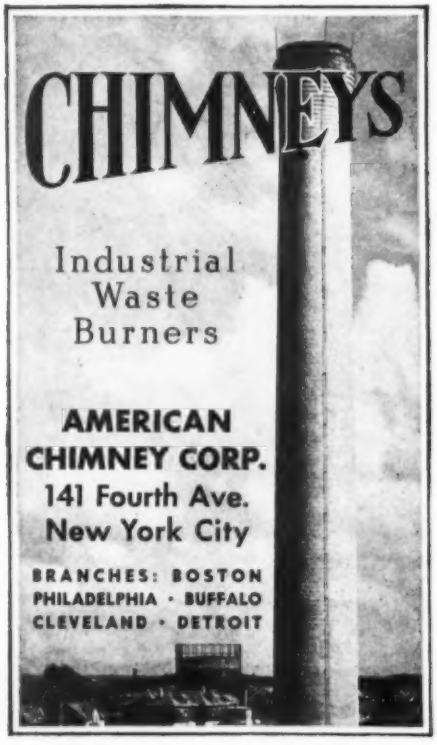

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For a fast and thorough removal of scale use a
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Write for Bulletin V-20
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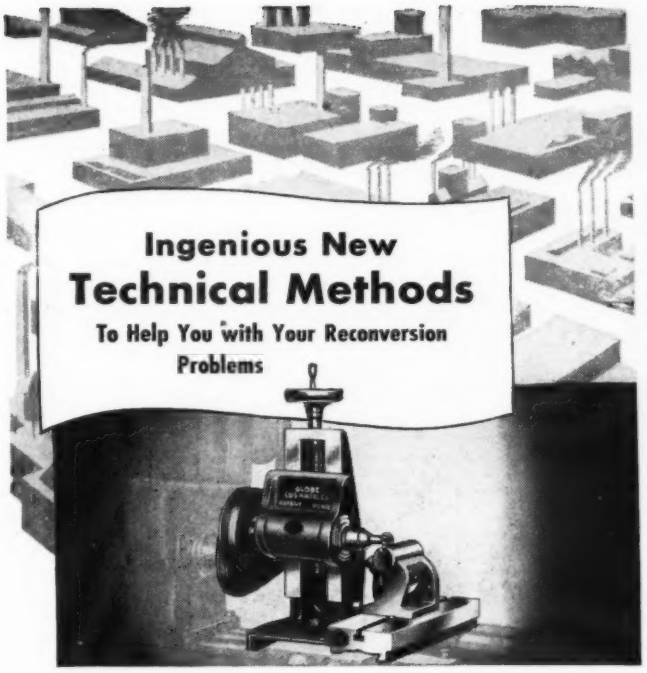

New Unit Makes Milling Machine Out of Lathe in 3 Minutes!

The Globe Miller, a unit quickly attached to a standard lathe, performs the same operations as a costly milling machine. Installed in 3 minutes or less, the Globe Miller operates almost identically to a standard milling machine. All controls are simple, highly accurate—and the miller is designed to utilize all speeds and feeds of the lathe.

It is accurate, durable and highly versatile. With minor adjustments and accessories, the miller will face castings; cut slots, keyways, and gears; perform slitting operations, etc. Quality materials and rugged construction enable it to stand the hardest use. It costs but a fraction as much as a standard miller. Its compact design makes storage possible underneath the lathe. Proved performance in wartime production, assures dependable service.

Performance has also proved that chewing gum helps you on the job—by seeming to make work go easier, time go faster. Today, you'll see good chewing gum on the market. But a shortage still exists. Wrigley's Spearmint Gum is taking this space for your information, and for now, we'd like to suggest that you use any good available brand. Remember: It's the chewing that's good for you.

You can get complete information from
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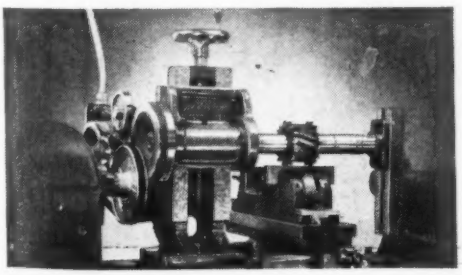
Los Angeles 34, California



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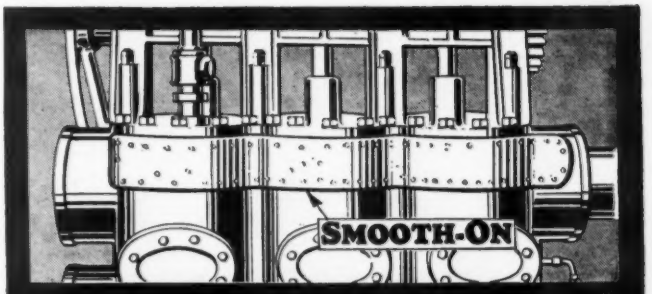

LEAKING STOPPED

in badly cracked cylinder block

A 15" x 12" triplex geared power pump in a Tennessee plant developed a crack that extended through all valve chambers, valve decks and one partition between plunger cylinders. The typical Smooth-On repair shown here put the pump back in service.

First, the entire crack was filled in with Smooth-On No. 1 Iron Repair Cement. Then a shaped metal patch, coated with Smooth-On, was bolted through valve chamber covers and valve decks into solid iron. After the Smooth-On had hardened, the pump resumed operation without leakage.

For more than 50 years, Smooth-On No. 1 has been a standby with mechanics, repair and maintenance men for sealing cracks, stopping leaks and tightening loose parts. Economical. Easy to use. Gives lasting results. Applied like putty, it sets to metallic hardness, expanding slightly, insuring tight repairs.

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FREE **POPULAR REPAIR HANDBOOK**

40 pages. 170 diagrams. Clear instructions for many short-cut, practical, tested repairs to plant equipment. Pocket size—and should be in the pocket of every engineer and mechanic. Yours, for just sending the coupon.

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Do it with SMOOTH-ON
The Iron Repair Cement of 1000 Uses

For Low Cost, High Efficiency Water Treatment use MANZEL CHEMICAL FEEDERS!

Manzel Feeders inject boiler compound in accurately measured amounts with clock-like regularity. They never forget, and every gallon of water gets the same amount of chemical. Manzels are installed directly on the feedwater pump and start, stop, speed up and slow down with it. Once feed is set, they require no attention except to maintain chemical supply in chemical tank.

Feed is very accurate and may be adjusted while Feeder is operating. Your boiler compound goes further and does a better job when injected by Manzel Feeders.

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Stops Leaks— Prevents Scoring

ALLPAX

This universal packing — consisting of long, tough fibrous asbestos fibres, thin flakes of anti-friction metal, minute graphite scales and a heat-proof lubricant — is recommended for general service against steam, water, air, ammonia, oils, gases, etc. where temperatures do not exceed 600°F. Fits all sizes and shapes of stuffing boxes. Special styles available for high temperature and corrosive liquids, for products, etc. Try it and you'll use it regularly.

Distributors everywhere

THE ALLPAX CO., INC., MAMARONECK, N. Y.

Coming in the April Issue of Power—

A Special Section on

PRESSURE AND TEMPERATURE CONTROLS

WHITLOCK STAGE HEATERS . . . ENGINEERED FOR POWER PLANTS

Overall dimensions—63" O.D. x 22'1½" long.
Net Weight 45,000 lbs.—Surface 2,650 sq. ft.
Design Pressure—Shell 150 lbs., Tubes 900 lbs.

• Whitlock stage heaters, utilizing bled steam, are helping to maintain the best overall heat balance in central power stations. The heaters are designed to raise feed water temperatures about 100 degrees per stage and are fabricated in straight tube floating head or U-tube construction.

Typical of Whitlock engineered design is the unit shown. Built for 150 lb. shell side working pressure and 900 lb. tube side working pressure, this heater incorporates a forged steel "monobloc" channel design to reduce the total channel pressure area.

Whitlock design of heat transfer equipment has a background of over 50 years' continuous service to power plants—high pressure heaters for today's high pressure plants are a Whitlock specialty. Bring your heat exchanger problems to Whitlock engineers for recommendations.

WHITLOCK MANUFACTURING COMPANY

46 South St., Elmwood, Hartford 1, Conn.

New York Boston Chicago Philadelphia Detroit Richmond

In Canada: Darling Brothers, Ltd., Montreal

Authorized representatives in other principal cities. Ahead of the times for half a century.

SEARCHLIGHT SECTION

EMPLOYMENT • BUSINESS • OPPORTUNITIES • EQUIPMENT—USED or RESALE

UNDISPLAYED RATE:
(Not available for equipment advertising)
15 cents a word, minimum charge $3.00. (See ¶ on Box Numbers.)
POSITIONS WANTED (full or part-time individual salaried employment only), ½ the above rates.
PROPOSALS, 75 cents a line an insertion.

INFORMATION
BOX NUMBERS in care of any of our New York, Chicago or San Francisco offices count 10 words additional in undisplayed ads.

DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED RATE:
The advertising rate is $8.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page.

NEW ADVERTISEMENTS received by February 13th will appear in the March issue, subject to limitation of space available

WANTED

Young Electrical Engineers

For work in Engineering Department of Electric Utility Company. State full details as to experience.

OTTER TAIL POWER COMPANY
Fergus Falls, Minnesota

WANTED

OPERATING ENGINEER

Capable of taking charge of mechanical equipment including power plant in sugar factory in West Indies. Knowledge of Spanish desirable but not necessary. Give full details of education and experience and salary required.

P-983, Power
330 W. 42nd St., New York 18, N. Y.

To EMPLOYERS who advertise for MEN:

THE letters you receive in answer to your advertisements are submitted by the applicants with the hope of securing the position offered.

Frequently when there are many applicants, the only letters acknowledged are those of the most promising candidates. Others may not even receive the slightest indication that their letters have been received, much less considered. These men often become discouraged, will not respond to future advertisements, and sometimes even question their bona fide character.

Every advertisement printed in the searchlight section is duly authorized.

It will help to keep readers interested in this advertising if you will make it a practice to acknowledge every application received, even if you merely return the letters of unsuccessful applicants marked, "Position filled, thank you." If you don't care to reveal your identity, you might mail them in plain envelopes.

This suggestion is made in a spirit of friendly co-operation between employers and the men replying to Positions Vacant advertisements.

Departmental Staff
McGRAW-HILL
PUBLISHING CO., INC.

★

"Put yourself in his place"

WANTED

MECHANICAL DESIGNERS

Experienced in power, industrial, and processing plants. Location, New York City.

EBASCO SERVICES INC.
2 Rector St. N.Y.C. 6

WANTED—SUPERINTENDENT OF POWER

28-35 Mechanical or electrical graduate. Must have previous experience in power plant maintenance and operation, and the design and construction of power distribution systems. Location: India. State age, experience, marital status, details of education, present salary and salary expected. Send photograph.

P-972, Power
330 West 42nd St., New York 18, N. Y.

POSITIONS VACANT

DESIGN DRAFTSMEN and detailers to work on steam turbines. Previous turbine experience desirable but not necessary. Worthington Pump and Machinery Corp., Moore Steam Turbine Division, Wellsville, New York.

TECHNICAL GRADUATES (especially chemical, electrical) under 30, returning from service have excellent opportunity for permanent place with nation-wide engineering organization. After training period, work as junior engineer will include traveling for consultation among leading industrial plants. Enclose photo when answering. P-988, Power, 330 W. 42nd St., New York 18, N. Y.

DIESEL PLANT Engineer for operation and maintenance utility power plant located Guayaquil, Ecuador. Man with extensive diesel maintenance and installation experience preferred. Will consider technical graduates with maintenance and operating experience. Prefer men with stationary plant experience. Spanish desirable not essential to start. Apply by letter giving details education, training and experience and salary earned in each position. P-989, Power, 330 W. 42nd St., New York 18, N. Y.

PLANT ENGINEER—M.E. Graduate, permanent position, processing work requiring material handling, structural design, electrical and steam distribution, estimating, give education experience, references. P-990, Power, 520 N. Michigan Ave., Chicago 11, Ill.

POWER PLANT machinery inspection engineer wanted by leading boiler and machinery insurance company. Locations: Spartanburg, South Carolina and Chicago, Illinois. Technical graduates not over 38 preferred. Practical experience in the operation or maintenance of prime movers and electrical equipment necessary. Permanent position with good future possibilities. In reply, give age, employment record and salary expected. P-991, Power, 330 W. 42nd St., New York 18, N. Y.

(Continued on page 334)

Don't forget the

BOX NUMBER

When answering the classified advertisements in this magazine don't forget to put the box number on your envelope. It is our only means of identifying the advertisement you are answering.

WANTED

DESIGNERS
ARCHITECTURAL
STRUCTURAL
POWER PIPING
ELECTRICAL

5 to 10 yrs. experience required in Power Plant or Heavy Industrial Structures. Positions in Philadelphia

United Engineers & Constructors Inc.
1401 Arch St. Phila. 5, Pa.

WANTED

General Plant Superintendent

Power Company operating interconnected system with numerous plants in three states in North Central United States is looking for experienced man, age 40 to 50 years, to supervise operations and maintenance all plants. Must be executive type with technical training in combustion and mechanical engineering and broad operating experience in steam power plants. Diesel and water power experience desirable. Headquarters in city of 12,000. Considerable traveling around territory necessary. Permanent and highly responsible position with locally controlled and operated Company for right man. Applicants should state complete history of experience and education, previous positions held and duration, with reasons for changes. Include photograph and references. State salary expected.

OTTER TAIL POWER COMPANY
Fergus Falls, Minnesota

ENGINEER
WANTED

For top supervisory technical position in large New York hotel. Graduate engineer preferred. Should be between the ages of 40 and 50, and have Marine, Industrial or building plant operating experience. Apply by letter giving salary expected and complete information regarding education and positions held.

P-982, Power
330 West 42nd St., New York 18, N. Y.

WANTED

POWER PLANT

Switchboard and turbine operators, mechanics, asbestos workers and firemen for permanent positions in large plant in vicinity of Richmond, Virginia. No labor troubles. Wages comparable with those in area. State availability with complete details of experience.

P-986, Power
330 W. 42nd St., New York 18, N. Y.

(Continued from page 333)

EMPLOYMENT SERVICE

SALARIED POSITIONS $2,500-$25,000. This thoroughly organized confidential service of 36 years' recognized standing and reputation carries on preliminary negotiations for supervisory, technical and executive positions of the calibre indicated, through a procedure individualized to each client's requirements. Retaining fee protected by refund provision. Identity covered and present position protected. Send only name and address for details. R. W. Bixby, Inc., 270 Dun Bldg., Buffalo 2, N. Y.

POSITIONS WANTED

POWER ENGINEER: 25 years exp. plant maint. & oper. heat balance, fuel economics. I.C.S.M.E. PW-944, Power, 330 W. 42nd St., New York 18, N. Y.

SALES ENGINEER: B.S. in E.E. with 20 years sales experience in selling electrical and mechanical equipment. Dealing with southern utilities, industrial plants, architects and designing engineers. Field officer being released from the Army Air Forces and desires position. Married—one child. Will go anywhere in states. PW-992, Power, 330 W. 42nd St., New York 18, N. Y.

PLANT ELECTRICAL Engineer, fourteen years experience in design, construction, testing and maintenance of industrial electrical installations with leading steel and by-product coke manufacturer and shipyard. Desires similar position with progressive firm. PW-993, Power, 330 W. 42nd St., New York 18, N. Y.

AVAILABLE CENTRIFUGAL Engineer and designer with modern engineering practice, including knowledge of standardization of products. Engineering training and experience covers wide field. PW-994, Power, 520 N. Michigan Ave., Chicago 11, Ill.

SELLING OPPORTUNITY WANTED

CONTACTING ALL steam plants, architects, and consulting engineers in Florida and Southern Georgia. Want exclusive sales rights on industrial accounts. RA-977, Power, 330 W. 42nd St., New York 18, N. Y.

Long Established Reputable Concern with Substantial Capital

WILL BUY FOR CASH

Assets, Capital Stock, Family Holdings of

INDUSTRIAL PLANTS, MFG. DIVISIONS, UNITS

Among other considerations, you may realize certain desirable tax advantages

We are principals and act only in strictest confidence, retaining personnel wherever possible. Address

Box 1234, 1474 Broadway, New York (18), N. Y.

NEW PRODUCTS WANTED

Our client, an established manufacturer, wants new products or new ideas that might be developed into new products.

Experienced in steel casting, welding and machining in any combinations—large sizes, great precision.

Selling industrial and manufacturing markets.

Please write Dept. 10. Communications in confidence. We are fully compensated by our client.

CHARLES H. WELLING & CO., INC.
52 Vanderbilt Ave., New York 17, N. Y.
New Products—New Processes

Process and Power Plant Piping, Industrial Design, Mechanical Equipment, Structural Detailing, Stress Analysis. Alignment Charts.

Technical Design Corporation
90 West Street New York 6, N. Y.

At Your Service . . .

The Searchlight Section is at your service for bringing business needs or "opportunities" to the attention of men associated in executive, management, sales and responsible technical, engineering and operating capacities with the industries served by McGraw-Hill publications.

SALES ENGINEER

Familiar with power plants, to take full charge of long established branch office. This opening made available through the expansion of our business and promotions in our organization. Locations Chicago, Philadelphia, or Detroit.

The Dampney Company of America
Hyde Park, Boston 36, Mass.

WANTED

European Sales

H. E. LOEFFLER

formerly connected with Loeffler Highpressure boiler interests and heavy industry in Europe, now has his own export organization and can serve American firms and products.

Wide connections in Europe will be available. Firms who want to sell, produce or be efficiently represented in Europe (where Dr. Loeffler will travel in the near future) *please contact*

STIMAX TRADING CORP.
Leesburg, Va. (near Washington, D. C.)
Telephone: Leesburg 331 W.

Cash Ready

FOR YOUR

ELECTRICAL EQUIPMENT

Electric motors, AC and DC
Compensators
Generators
Motor Generator Sets
Air and Oil Circuit Breakers
Panels
Exhaust Fans
Control Equipment

Send us list with full details
WIRE OR PHONE
P. O. Box 534

POWER EQUIPMENT CO.
154 ANDREWS ST. ROCHESTER 4, N. Y.
Telephone Main 568 or 569

WANTED

Two D.C. MOTORS

TYPE MPC, CLASS 6—150 H.P. 500. Form A, 500 R.P.M. 250 Volts. General Electric—150 H.P.

W-973, Power
330 West 42nd St., New York 18, N. Y.

WANTED

500 to 750 KW 80% P.F., 3 phase 60 cycle, 2300 volt non-condensing turbo generator 175-200 lb., 100 degree superheat 20 lb. back pressure. State age, serial number, condition and price.

W-980, Power
520 North Michigan Ave., Chicago 11, Ill.

WANTED

DIESEL ENGINE GENERATOR UNITS

2000 H.P. to 4500 H.P.—Total—9000 H.P. Prefer complete generating plant. Engines only will be considered.

W-979, Power
330 West 42nd St., New York 18, N. Y.

Recent graduate M.E. from Univ. of Michigan seeks connection with organization in the power industry. Prefer turbine or similar activity with prospect of eventual arrival at sales engineer position. Available after March 1st. Location in Midwest preferred.

SA-984, Power
520 N. Michigan Ave., Chicago 11, Ill.

WANTED IMMEDIATELY

ELECTRIC MOTORS
MOTOR GENERATORS
LARGE AIR COMPRESSORS

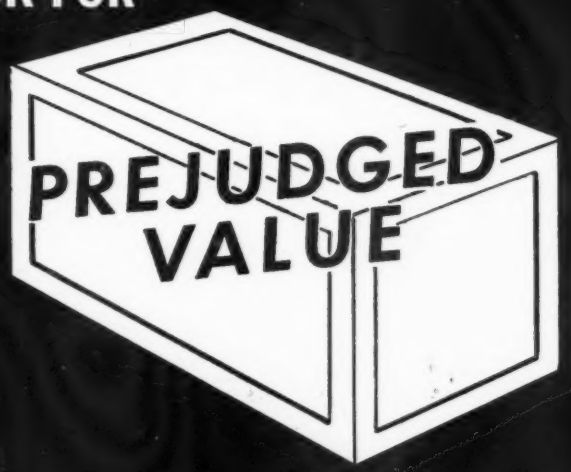
PAUL JAY
401 Broadway New York 13, N. Y.

WANTED FOR CASH

4000 to 5000 KW 80% P.F., 3 phase, 60 cycle, 4000/2300 volt, 3600 RPM condensing turbine generator unit, 350 to 400#, 700° TT complete with surface condenser, exciter, and switchboard.

W-987, Power
520 N. Michigan Ave., Chicago 11, Ill.

WHEN YOU BUY USED EQUIPMENT LOOK FOR



When used equipment is rebuilt in the Hemphill Shops it is rebuilt to the same HIGH STANDARDS of workmanship and performance as those of the original manufacturer. All Hemphill rebuilding and testing is done under the supervision of Electrical Engineers. This is a *plus-value* you get in Hemphill Equipment.

HEMPHILL VALUES ARE PREJUDGED

MOTOR GENERATOR SETS

1—150 KW. 125 Volt Westinghouse, Squirrel Cage
2—100 KW. 230 Volt General Electric, 440 volt, 3 phase, 1200 RPM. Sq. Cage
1—75 KW. 125 Volt General Electric, Squirrel Cage

TURBO GENERATORS

1—600 KW. Terry dual bleeder condensing Turbine only
1—300 KW. 125/250 Volt General Electric non-condensing
1—300 KW. General Electric, 3 phase, 60 cycle, 220 volt cond.
1—200 KW. General Electric, 3 phase, 60 cycle, 220 volt cond.
1—30 KW. 135 volt, Allis-Chalmers, non-cond.

ALTERNATORS

1—500 KW. 3600 RPM. 600 volt, General Electric D.C. exciter
1—200 KVA 3600 RPM. 240 volt, Allis-Chalmers D.C. exciter
1—180 KW. 514 RPM. 550 volt, Westinghouse
1—165 KW. 514 RPM. 2400 volt. Electric Mach.
1—150 KW. 900 RPM. 2300 volt, General Electric, type ATB
1—62½ KW. 3600 RPM. 220 volt, Allis-Chalmers
1—40 KW. 1800 RPM. 550 volt, General Electric
1—35 KW. 1200 RPM. 240 volt, Columbia Electric D.C. exciter
1—31.3 KVA. 1200 RPM. 120/208 volt, American D.C. exciter
1—12.5 KVA. 1200 RPM. 240 volt, Westinghouse, D.C. exciter

MOTORS—VARIABLE SPEED
230 VOLTS

2—200 H.P. 425/212 RPM. General Electric MPC
2—100 H.P. 950/1170 RPM. General Electric RC-37
1—60 H.P. 500/1000 RPM. Diehl
1—40 H.P. 700/1000 RPM. Sprague L.C.
1—30 H.P. 400/1200 RPM. General Electric R' C-204
1—30 H.P. 225/900 RPM. Crocker Wheeler CMC
1—25 H.P. 650/2200 RPM. Westinghouse SK-110L.
1—25 H.P. 500/1500 RPM. General Electric RF-12
1—25 H.P. 400/1200 RPM. Westinghouse SK
2—25 H.P. 300/900 RPM. Electro Dynamic
1—15 H.P. 300/1200 RPM. General Electric RLC-2024
1—13/18 H.P. 350/1200 RPM. Electro Dynamic
3—11½ H.P. 500/1500 RPM. Westinghouse
1—7½/10 H.P. 500/1500 RPM. Reliance
1—6/7.5 H.P. 450/1800 RPM. Crocker Wheeler CMC
1—5 H.P. 500/1500 RPM. Reliance
1—5 H.P. 600/1200 RPM. General Electric LC
1—5 H.P. 450/1800 RPM. Crocker Wheeler CM
1—5 H.P. 400/1600 RPM. Diehl K6
1—5 H.P. 225/900 RPM. Electro Dynamic

TRANSFORMERS

2—400 KVA. General Electric, 4156-250/480 volt, Scott taps
3—300 KVA. Pittsburgh 7800/440 volt
3—150 KVA. General Electric 33000/2300/4000Y
3—150 KVA. General Electric 2200/220/440 volt
1—100 KVA. General Electric 2200/220/440 volt
3—100 KVA. Westinghouse 11430/250 volt
3—100 KVA. General Electric 13200/250 volt
3— 75 KVA. General Electric 13500/750/440 volt
1— 75 KVA. General Electric, 3 phase, 4156Y-120/208Y
2— 50 KVA. Pittsburgh 7500/15000 Y. 110/220 v.
2— 15 KVA. General Electric 2300-115/230 volt
3— 75 KVA. General Electric, 2300-220/440 volt

GASOLINE DRIVEN
D. C. GENERATOR SETS

2—25 KW. 125 volt
1—30 KW. 125 volt
1—120 KW. A.C. 240 volt, 3 phase

MOTORS 3 PHASE 60 CYCLE
SQUIRREL CAGE

1—400 H.P. 1200 RPM. Westinghouse 220 volt
1—150 H.P. 1750 RPM. General Electric IK 440 volt
1—150 H.P. 870 RPM. General Electric HI-15 230 volt
1—150 H.P. 720 RPM. General Electric IK 440 volt
1—150 H.P. 400 RPM. General Electric I-17 440 volt
1—125 H.P. 1750 RPM. Cont. Electric 2200 volt
2—100 H.P. 1800 RPM. General Electric IK 440 volt
1—100 H.P. 425 RPM. General Electric HI-16 440 volt
1— 90 H.P. 380 RPM. Crocker-Wheeler 550 volt
1— 75 H.P. 870 RPM. Allis-Chalmers ARZ 220 volt
1— 75 H.P. 690 RPM. Westinghouse 550 volt
1— 60 H.P. 900 RPM. Howell Mfg. Co. SC. 220 volt
2— 50 H.P. 900 RPM. Fairbanks-Morse H. 220 volt
1— 50 H.P. 695 RPM. General Electric IK 220 volt
1— 50 H.P. 680 RPM. Westinghouse 220 volt
2— 50 H.P. 565 RPM. Westinghouse 440 volt
1— 50 H.P. 575 RPM. General Electric IK 220 volt
1— 50 H.P. 514 RPM. General Electric IQK 220 volt

MOTORS 3 PHASE 60 CYCLE
SLIP RING

1—500 H.P. 900 RPM. Lincoln 440 volt
1—350 H.P. 293 RPM. General Electric MT-424 440 volt
1—250 H.P. 600 RPM. General Electric 1M 2200 volt
1—225 H.P. 1800 RPM. General Electric I-E 220 volt
1—200 H.P. 600 RPM. Crocker Wheeler S.R. 440 volt
1—200 H.P. 600 RPM. Westinghouse CW 220 volt
1—150 H.P. 1750 RPM. Westinghouse CW 220 volt
1—100 H.P. 720 RPM. General Electric IM 220 volt
1—100 H.P. 720 RPM. Westinghouse CW 440 volt
1—100 H.P. 695 RPM. General Electric IM 440 volt
1— 75 H.P. 900 RPM. Allis-Chalmers 2K 220 volt
1— 75 H.P. 900 RPM. General Electric ITC 220 volt
1— 75 H.P. 690 RPM. Allis-Chalmers 220 volt
1— 75 H.P. 570 RPM. General Electric 1M 220 volt
1— 60 H.P. 575 RPM. Allis-Chalmers 220 volt
1— 50 H.P. 900 RPM. General Electric IM 220 volt
1— 40 H.P. 1150 RPM. Cont. Electric SA85 220 volt
1— 40 H.P. 1130 RPM. General Electric MT 2200 volt

MOTORS D. C. 230 VOLTS

2—450 H.P. General Electric MPL 250 volt
1—250 H.P. 750 RPM. Electro Dynamic 230 volt
1—100 H.P. 625 RPM. General Electric-Sprague LC 230 volt
1— 80 H.P. 600 RPM. Crocker-Wheeler CMC 230 volt
1— 75 H.P. 575 RPM. General Electric C 230 volt
1— 66 H.P. 535 RPM. Crocker Wheeler SCM 230 volt
4— 50 H.P. 700 RPM. Crocker Wheeler CM 230 volt
2— 30 H.P. 1150 RPM. General Electric RC-31 230 volt
1— 30 H.P. 1100 RPM. General Electric RC-12 230 volt
1— 30 H.P. 750 RPM. General Electric RC-14 230 volt
1— 30 H.P. 725 RPM. Westinghouse SK 230 volt
1— 30 H.P. 625 RPM. General Electric C 230 volt
1— 25 H.P. 1150 RPM. General Electric CD-93 230 volt
1— 25 H.P. 775 RPM. General Electric RC-13 230 volt
1— 25 H.P. 775 RPM. General Electric RC 230 volt
1— 25 H.P. 600 RPM. Westinghouse SK 230 volt
1— 20 H.P. 800 RPM. General Electric RC-12 230 volt
1— 15 H.P. 1750 RPM. General Electric CD-67 230 volt
1— 15 H.P. 350 RPM. Diehl G-312 230 volt

THIS SEAL IS YOUR GUARANTEE

"FOR POWER"

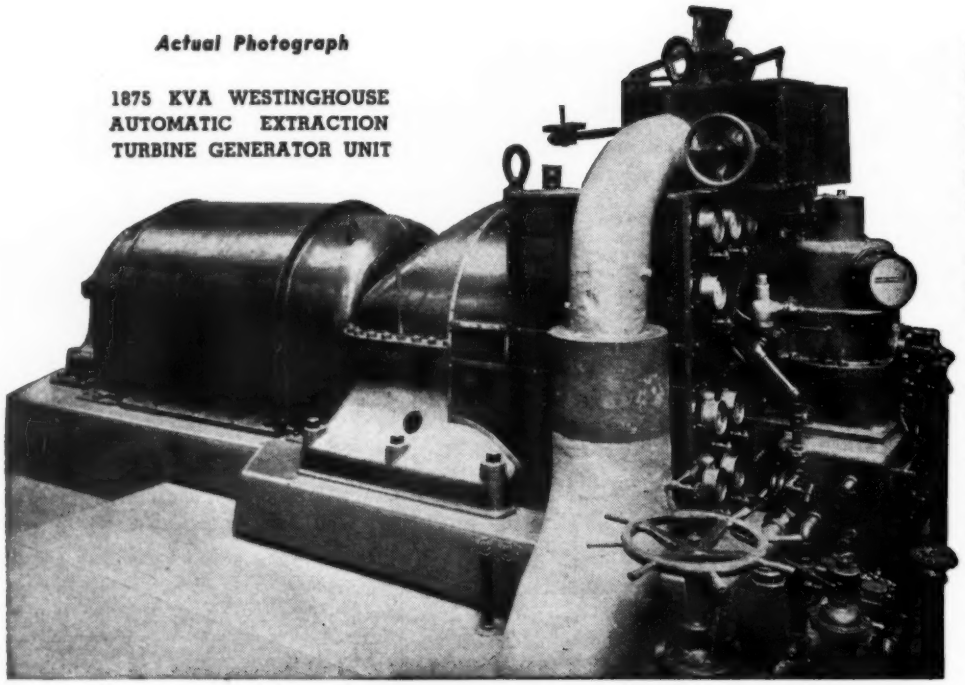
J. L. HEMPHILL & CO.

1601 53rd STREET, NORTH BERGEN, N. J.
PHONE NEW YORK—LONGACRE 5-3227
PHONE NEW JERSEY—UNION 3-2600

POWER PLANT MACHINERY

Actual Photograph

1875 KVA WESTINGHOUSE AUTOMATIC EXTRACTION TURBINE GENERATOR UNIT



1875 KVA Westinghouse alternating current generator 3 phase 60 cycle, 480 volts, 3600 RPM, direct connected to Westinghouse automatic extraction type condensing turbine, 175-250 lbs. steam pressure, 600 degrees maximum T.T., 0-25 lbs. extraction pressure, 3600 RPM.

Generator equipped with air filter, exciter and switchboard. Turbine equipped with 3200 sq. ft. Wheeler surface condenser, pumps, air ejectors, interconnecting piping and cooling tower.

Installed new 1923
Used only part time
Excellent condition

TURBINE UNITS

3 Phase 60 Cycle

15000 KVA G.E. 13800 V. Cond. 200#.
10000 KVA G.E. 4000 V. Cond. 200#
6250 KVA G.E. 2300 V. Cond. 175#.
5000 KVA G.E. 4000 V. Cond. 200#
4000 KVA Allis 600 V. Cond. 150#.
3750 KVA G.E. 480 V. Cond. 200#.
2500 KVA Wst. 2300 V. Cond. 200#.
1875 KVA G.E. 2300 V. Cond. 175#.
1563 KVA Allis 200 V. Cond. 200#.
1250 KVA G.E. 2300 V. Bleed. 150#.
625 KVA Wst. 480 V. Bleed. 150#.

WATERTUBE BOILERS

1300 HP Springfield 400# Pulverizer.
1000 HP Sterling 200# Pulverizer.
750 HP Sterling 250# Stoker.
484 HP Springfield 200# Oil Burners.
400 HP Sterling 250# Stoker.

UNIFLOW UNITS

3 Phase 60 Cycle

750 KVA Skinner 2300 volt 200#.
675 KVA Ames 480 volt 150#.
625 KVA Chuse 480 volt 150#.
480 KVA Skinner 480 volt 175#.
375 KVA Skinner Vert. 240 volt 150#.
365 KVA Skinner 240 volt 150#.
260 KVA Skinner 240 volt 150#.
250 KVA Ames Vert. 240 volt 150#.
210 KVA Ames 2300 volt 150#.
156 KVA Skinner 240 volt 150#.

UNIFLOW UNITS

Direct Current

600 KW Skinner Vert. 250 volt 150#.
300 KW Skinner 250 volt 150#.
200 KW Skinner 125 volt 125#.
150 KW Ames 250 volt 125#.

DIESEL UNITS

3 Phase 60 Cycle

1000 KVA McInt. & Sey. 4000 V. 300 RPM.
625 KVA Busch Sulz. 2300 V. 180 RPM.
500 KVA Fair. Morse 2300 V. 257 RPM.
437 KVA Busch Sulz. 2300 V. 200 RPM.
375 KVA DeLavergne 2300 V. 300 RPM.
350 KVA Fair. Morse 2300 V. 300 RPM.
312 KVA Busch Sulz. 2300 V. 360 RPM.
300 KVA Fair. Morse 2300 V. 257 RPM.
200 KVA Fair. Morse 2300 V. 257 RPM.
175 KVA Buckeye 240 V. 450 RPM.
156 KVA Buckeye 240 V. 514 RPM.
118 KVA Winton 240 V. 400 RPM.

MOTOR GENERATORS

3 Phase 60 Cycle

1500 KW G.E. Syn. 275 D.C. 11500 A.C.
400 KW G.E. Syn. 275 D.C. 440 A.C.
200 KW G.E. Syn. 275 D.C. 2300 A.C.
150 KW West. Syn. 275 D.C. 440 A.C.

INTERNATIONAL POWER MACHINERY CO.

UNION COMMERCE BLDG. Telephone: MAin 9514 CLEVELAND 14, OHIO

Let's get down to Belyea Brass Tacks

WHAT
BELYEA
RE-NU-BILT
SIGNIFIES

Because WE Own It . . .
. . . YOU Get It Quicker

You get RE-NU-BILT Equipment with minimum delay because we *own* what we advertise. We do not have to use up time for negotiation after your order is placed. Our workmen have been specially trained to rebuild electrical power equipment and therefore do the rebuilding in a minimum time.

Here Is A List of Today's RE-NU-BILT EQUIPMENT . . .

. . . With A Guarantee of SUCCESSFUL OPERATION

MOTOR GENERATOR SETS

3 phase—60 cycle

1—300 KW Whse. 600 v. D.C. to 450 HP. 2300 v. Syn. with exciter.
1—175 KW. Whse. 250 v. D.C. to 312 Kva., 2300 v. Syn. with exciter.
1—150 KW—Whse. 600 V. D.C. to 200 HP—2200 V.
1—150 KW Whse. 3 unit (2) 75 KW 125 V. Gen. D.C. to 200 HP—2300 V. Ind.
1—75 KW GE 125 V. D.C. to 120 HP—2300/4000 V. Ind.
1—50 KW GE 125 V. D.C. to 75 HP—2300/4000 V. Ind.
1—26.4 KW W.E. 33 v. 800 amp. D.C. to 41.5 HP. 220 v. Sq. Cg.
1—19.8 KW W.E. 33 v. 600 amp. D.C. to 32 HP. 220 v. Sq. Cg.

SPECIAL

1—500 KW—GE 250 V D.C. to 700 HP—2300/4150 Syn. Motor—3 phase—25 cycle with Controls.

TRANSFORMERS—60 Cycle

Qu.	Kva.	Make	Ph.	Type	Voltages
3	1667	Pitts.	1	OISC	13200x2300
1	1050	G.E.	3	WCTH	11000x445/222½
4	525	G.E.	1	HJ	2300x445
4	500	Pitts.	1	OISC	13200x2300
2	333	Pitts.	1	OISC	2400x220
1	300	Pitts.	3	OISC	4150x208/120
3	200	G.E.	1	HLLD	27600x115/460
2	200	G.E.	1	HKDD	13800x220/440
1	200	Whse.	1	JK	6600x220/440
3	200	G.E.	1	HJ	2300x408/204
1	200	G.E.	2-3	Auto	2500x2500
1	200	G.E.	1	H	2300x115/230
1	125	Maloney	1	C	2300x230/460
3	100	G.E.	1	HJDD	13200x445/226
3	100	Whse.	1	OISC	13200x250

A. C. MOTORS

3 Phase—60 Cycle
SLIP RING

Qu.	H.P.	Make	Volts	R.P.M.	Desc.
1	2500	G.E.	6600	253	MT
1	800	Al. Ch.	440	885	ANY
1	600	Cr. Wh.	2200	507	131 AQ
1	600	G.E.	2300	600	MT-422-3 Brg.
1	600	Whse.	440	400	CW
1	500	Al. Ch.	2200	590	ANY-36
1	400	G.E	2200	252	1P
1	400	Cr. Wh.	440	590	29Q
1	350	G.E.	4000/2300	253	MT-442Y
1	300	G.E.	440	585	IM-17B
1	300	Cr. Wh.	440	440	29Q
1	250	G.E.	4000	257	MT-424Y
1	200	G.E.	440	450	IM-3 Brg.
1	200	G.E.	2200	600	IM

SQUIRREL CAGE

1	400	G.E.	2200	1175	IE-15B
1	300	G.E.	440	900	1K
1	200	Whse.	2200	1800	C8
1	200	G.E.	550	580	IK
1	200	G.E.	2200	490	IK
2	200	G.E.	2300	1175	IK
1	200	G.E.	440	580	IK
1	200	Al. Ch.	2300	1175	
2	175/112	G.E.	440	900/720	IK
1	150	Whse.	550	400	CS-594A
3	150	G.E.	440	1200	K-6325S B. Brg.

SYNCHRONOUS

2	2100	G.E.	2300 4400	514	ATI
1	600	Al. Ch.	2200	720	
1	75	G.E.	220	600	TS-7556

SYNCHRONOUS CONDENSER

1	5000	Whse.	2300/4000	900	

ROTARY CONVERTERS

3 PHASE—60 CYCLE

Qu.	Kw.	Make	Speed	D.C.V.	Trans. V
1	1500	Whse.	720	600	2300
1	1500	Whse.	600	600	11500
1	1250	G.E.	720	250	2300
1	1000	G.E.	900	600	13200
1	1000	Whse.	900	600	11000
2	750	G.E.	1200	600	2300
1	750	Whse.	720	250	6600/2300
1	500	Whse.	1200	600	13200/2300
2	375	G.E.	1200	250	6600/2300
1	300	G.E.	1200	600	2300

3 PHASE—25 CYCLE—BOOSTER TYPE

2	1500	G.E.	500	225/275	13200/6600

All units can be furnished with A. C. & D. C. control

SPECIAL

1—2000 amp., 3 pole, 15000 V. Condit type F-120-15 D, 230 V Sol. operated OCB —1000 000 uninterrupting Capacity.

D. C. MOTORS

Qu.	H.P.	Make	Type	Volts	Speed
2	1250	G.E.	MPC	500	130
1	800	G.E.	MPC	550	600
1	650	G.E.	MPC	250	115/145
2	625	G.E.	MPC	500	130
1	500	G.E.	MPC	230	900
3	350	G.E.	MPC	230	450
1	300	G.E.	MPC	230	275/550
1	250	G.E.	MPC	230	400/500
1	250	Al. Ch.		230	525
1	250	Whse.	8K	230	275/690
1	200	Whse.	SK-191	230	850
2	135/175	G.E.	MCF	230	450/1050
1	150	G.E.	MPC	230	250/450
2	130	Cr. Wh.	CMC-65H	550	1200
2	125	G.E.	CO-1832	230	625

TURBO GENERATOR SETS

1—500 KW—Whse. 625 KVA, 440 v. 3 ph. 60 cy. 3600 RPM with Parsons 145/175 lbs. condensing turbine with jet condenser and accessories.
1—75 KW Ridgeway 250 V. D.C. with Terry 180 lb. with 12 lb. back pressure, 2000 RPM.

Have You Surplus Electrical Equipment? **WE BUY FOR STOCK — FOR CASH.**

Belyea

38TH YEAR OF SERVICE

COMPANY, INC.

Main Office & Shop

43 HOWELL ST., JERSEY CITY, N. J.

"SUCCESSFUL OPERATION GUARANTEED"

Dependable Rebuilt Electrical Equipment

1 YEAR GUARANTEE

3 Ph. Squirrel Cage Motors

Qu.	H.P.	Make		Speed
4	150	G. E.	KT-547S	1750
6	150	West.	CS-771.1S	1755
1	125	West.	CS	1150
1	125	West.	CS	690
1	147	West.	25 cyc.	715
2	100	G. E.	BTA-440V.	375/750
1	100	G. E.	KT-500	1150
1	100	West.	CS	575
1	90	Burke	EM7	1150
3	75	Gen. Elec.	IK	690
1	75	West.	CS	690
1	70	G. E.	Synch.	1200
1	85	G. E.	FT-529	3600
1	75	West.	CCL	870
1	75	Al. Chal.		860
1	60	Burke		575
3	60	G.E.&West.		690
1	50/25	G. E.	KG-504	1750/885
1	50	El. Dyn.	174BK	1750
1	50	G. E.	KT-326	1750
1	50	Star	A-75	1750
2	50	Al. Chal.		1160
1	50	West.	CCL	1150
1	50	Cr. Wh.	1220	1150
1	50	G. E.	KT-342	865
1	50	Cr. Wh.	122Q	865
1	50	G. E.	KT-346	690
1	50	West.	CS	580
1	50	G. E.	I-14	495
1	46	W. E.		150/900
1	40	G. E.	KT-332	1140
2	40	G. E.	KT-336	880
1	40	Triumph	TR	690
1	40	G. E.	KT-346	690
1	40	W. E.		150/900
2	35	West.	25 cyc.	1450
1	35	Wagner		850
1	35	West.	CS	685
1	30	U. S.	Vert.	3450
1	30	Cr. Wh.		870
1	30	Watson		850
1	30	West.	CS	850
1	30	West.	CCL	690
1	25	G. E.	KT-503	1750
1	25	Triumph	BL-11S	1750
1	25	G. E.	KT-302	1735
1	25	Wagner	Fy. Weich.	1200
1	25	Wagner	Vert.	1160
1	25	West.	CS-405	1160
5	25	West.	CS	1160
1	25	Century	AS-35	870
1	25	G. E.	IK	870
1	25	Wagner	Fy. Weich.	720
1	25/12½	G. E.	KR-445	840/405
1	20	West.	CS-365	3400
1	20	G. E.	KT-312	1700
1	20	G. E.	Vert.	1750
1	20	West.	CS-365	1150
1	20	R & M	K-207	1160
1	20	West.	CS	1150
2	20	F-M		1150
1	20	G. E.	Vert.	1175
1	20	Al. Ch.		870
1	20	Diehl		860
1	20	Al. Ch.		860
1	20	West.	C. I.	690
1	15	G. E.	KT-752	1750
1	15	Wagner	Fy. Weich.	1800
1	15	El. Spec.	Synch.	1800
1	15	West.	CCL	1750
1	15	G. E.	KT-312	1150
1	15	Howell		1150
1	15	Al. Ch.		1150
1	15	G. E.	KT-502	1170
1	15	G. E.	Vert.	1150
1	15	Lincoln		1150
4	15	West.	MS	1150
2	15	West.	CS-365	1160
1	15	G. E.	Vert.	870
1	15	G. E.	KT-512	870
1	15	Wagner	15VPR	860
1	15	Wagner	Fy. Weich.	720
12	15	West. and L. A.		600, 900, 1200, 1800
1	15	West.	CS-504	415

JUST RECEIVED

35—GEARED HEAD MOTORS LATEST TYPE

¼ H.P.—29 RPM
½ H.P.—148 RPM
¾ H.P.—148 RPM
1 H.P.—109 RPM
2 H.P.—525 RPM

LATEST TYPE

G.E. & WEST. NEMA FRAME MOTORS

7—¾ H.P. 1200 RPM Open
14—1½ H.P. 1800 RPM Open
2—3 H.P. 1200 RPM XP
7—5 H.P. 3600 RPM Open
4—5 H.P. 3600 RPM TEFC
7—7½ H.P. 1800 RPM Open
7—10 H.P. 3600 RPM Open
7—10 H.P. 1800 RPM Open
14—15 H.P. 1800 RPM Open
7—15 H.P. 1800 RPM TEFC

2 Ph. Squirrel Cage Motors

Qu.	H. P.	Make		Speed
1	100	West.	CS-663C	1750
1	100	G. E.	KQ-547	1155
1	70	G. E.	Synch.	1200
1	75	G. E.	IQE	1750
1	50	Lincoln	C-15	870
1	50	G. E.	IQ	870
1	40	Al. Ch.		870
1	35	Al. Ch.		870
1	30	West.	CCL	1150
1	30	Wagner	BP	1140
1	25	Burke		870
3	25	G. E.	IQL	1150
1	25	West.	CCL	1150
1	15	F-M		1750
1	15	Wagner		1750
1	15	G. E.	KQ-502	1150
1	15	West.	CS	1155
1	15	Al. Ch.		1130
1	15	West.	CS-572	860
1	15	G. E.	IQ	690

A.C. Slip Ring Motors

Qu.	H. P.	Make	Type	Speed
1	250	G. E.	IM	600
1	150	El. Dy.	L-263	1770
1	125	Al. Ch.		695
1	112	G. E.	ITC	720
1	100	G. E.	IM	720
1	100	F-M	BA	720
1	79	G. E.	IM	1150
1	79	West.	CW	1170
3	75	G.E.	M [illegible]-352	870
1	75	Al. Ch.	Hoist	575
1	64	G. E.	MTO-552	585
1	60	West.	CW-956A	290

A.C. Slip Ring Motors

Qu.	H. P.	Make	Type	Speed
1	52	G. E.	ITC	860
1	50	Al. Ch.		865
1	50	G. E.	MT-342	860
1	40	F-M	BB	1150
1	40	West.	CW	1150
1	40	West.	HF	850
1	40	Lincoln	IXL	690
1	40	G. E.	MT-352	570
1	35	Al. Ch.		870
1	35	Burke	DMB-7	720
1	30	G. E.	ITC	1200
1	30	G. E.	M-526	1150
1	30	G. E.	MQ-332	870
1	30	West.	CI-574A	870
4	30	West.	CI-582C	870
2	30	G. E.	MT-542	690
2	25	Al. Ch.		870
1	25	Howell	SRS-420	870
1	20	West.	CW	870
1	20	G. E.	MT-332	600
1	15	G. E.	MT-502	1130
1	15	West.	CW	870
1	15	G. E.	MT-512	845
1	15	Al. Ch.		680
2	15	G. E.	ITC-5010	695
1	15	G. E.	MQ-332	670

A.C. Generators

Qu	K.W.	Make	Voltage	Speed
1	150	G. E.	240/480	600
1	100	West.	240/480	600
1	50	G. E.	208/120	1200
1	50	F-M	240/480	1200
1	50	El. My.	208/120	900
1	30	Burke	220/440	900

230 Volt D.C. Motors

Qu.	H.P.	Make	Type	Speed
1	350	West.	SK	340/425
1	75	Burke	AM-158	575
1	60	G. E.	C-Inter.	480/1100
1	50	West.	SK-150	550/1100
1	50	G. E.	RC-19	400/1200
1	45	Diehl	K-10	850
1	40	G. E.	DLC	1050
2	35	West.	SK-120	1150
1	35	G. E.	RLC-204	440/800
2	35	West.	SK-160	400/600
1	30	G. E.	RC-32	1100
1	30	West.	SA	500/1500
3	25	G. E.	RC-31	1150
1	25	West.	SK	1100
1	25	Reliance	92T	1150
1	25	L-A	FNA-1043	900
1	25	A-L		850
1	25	Rel.	MS	500/1500
1	25	Rel.	H3	400/1200
1	25	G. E.	RF	400/1200
3	20	G. E.	RF	500/1500
1	20	G. E.	RF	400/1200
1	20	G. E.	CD-83	1200
1	20	R. & M.		1160
1	20	G. E.	RC-11	1150
1	20	Ele. Dyn.	7½-S	950
3	20	West.	SK-110L	750
1	20	West.	Hoist	700
1	20	West.	SK-120	300/1200
1	15	Rochester		3450
1	15	West.	SK-83	1150
2	15	G. E.	RC	1150
1	15	G. E.	CD-Vert.	900
1	15	G. E.	CD-85	850
2	15	G. E.	RC-30	850
1	15	Sprague	D	700
1	15	West.	SK	675/1350
1	15	West.	SK-100L	600/2500
1	9	L-A	Baler	1750
4	10	G. E.	RC	1150
2	10	G. E.	CD-75	1150
1	10	Diehl		900
1	10	G. E.	RC	29/850
1	10	G. E.	CD-83	850
1	10	Roth		800
1	10	Diehl	LS-14	750
1	10	West.	Elevator	700
1	10	G. E.	CVC	700
1	10	West.	SK	600/1200
1	10	G. E.	RLC	500/1500
1	10	West.	SK	500/1500

230 Volt D.C. Motors

Qu.	H.P.	Make	Type	Speed
1	10	El. Dyn.		450/1800
2	10	G. E.	RF-10	400/1600
2	10	West.	SA	400/1200
1	10	West.	SK-90	400/1200
1	10	Diehl		200/ 247
1	7½	Sturt.	TF	3600
1	7½	El. Dyn.	2S	1750
1	7½	G. E.	RC	1150
6	7½	West.	SK-40	1180
1	7½	G. E.	CO-1804	
1	8	L-A	Baler	1200
2	7½	West.	SK	850
2	7½	G. E.	RC	850
1	7½	West.	SK-60	850
2	7½	G. E.	RF-9	600/1800
1	7½	G. E.	RF-10A	600/1500
1	7½	West.	SK-90	650/1300
1	7½	El. Dyn.	3S	550/1650
1	7½	G. E.	RF-10	450/1800
1	7½	G. E.	RF-10	450/1600
1	7½	G. E.	RF	450/1800
2	7½	West.	SK-70	400/1600
1	7½	Al. Ch.		350/1050
1	7½	L-A	Baler	

110 Volt D.C. Motors

Qu.	H.P.	Make	Type	Speed
1	45	G. E.	RC	1100
2	10	Lincoln	I-SC	3500
1	10	L-A		3500
1	10	E. Dyn.	3S	1100
1	10	West.	SK-70	1150
1	10	Reliance		400/1600
2	10	Diehl		230
1	7½	G. E.	CVC	725
1	7½	El. Dyn.	5S	450/900
1	7	El. Dyn.		600/1200

D.C. Generators

KW	Make	Voltage	Ampere	Speed
300	Burke (2)	250/125	1200	900
300	West. (2)	250	1200	900
250	G. E.	125	2000	720
150	Cr. Wh.	125	1200	900
150	Ridgeway	250	600	900
100	Cr. Wh.	250	400	570
100	G. E.	125	800	1150
50	G. E. (2)	125	400	1150
50	G. E.	250	200	870
30	El. Dyn.	600	50	1150
30	G. E.	125	240	1150
25	G. E.	125	200	1150
20	West.	250	100	1150
10	West.	250	40	1150
10	West.	125	80	1150
7½	G. E.	250	30	1150
7½	West.	125	60	1150

AIR COMPRESSORS

12½" x 12"	American
10" x 6"	Gardner
9" x 8"	Ingersoll Rand
9" x 8"	Sullivan
7" x 6"	Ingersoll Rand

LARGE FANS

11—Buffalo and Sturtevant Latest Type—Like New—50,000 Cu. Ft., 17" Pressure at 1760 RPM.

D.C. to A.C. Generators
1 to 10 K.V.A.
115 and 230 V.D.C. to 1 ph. and 3 ph. 110-220 & 440 V. A.C.

THIS IS A PARTIAL LIST ONLY!

L. J. LAND & COMPANY

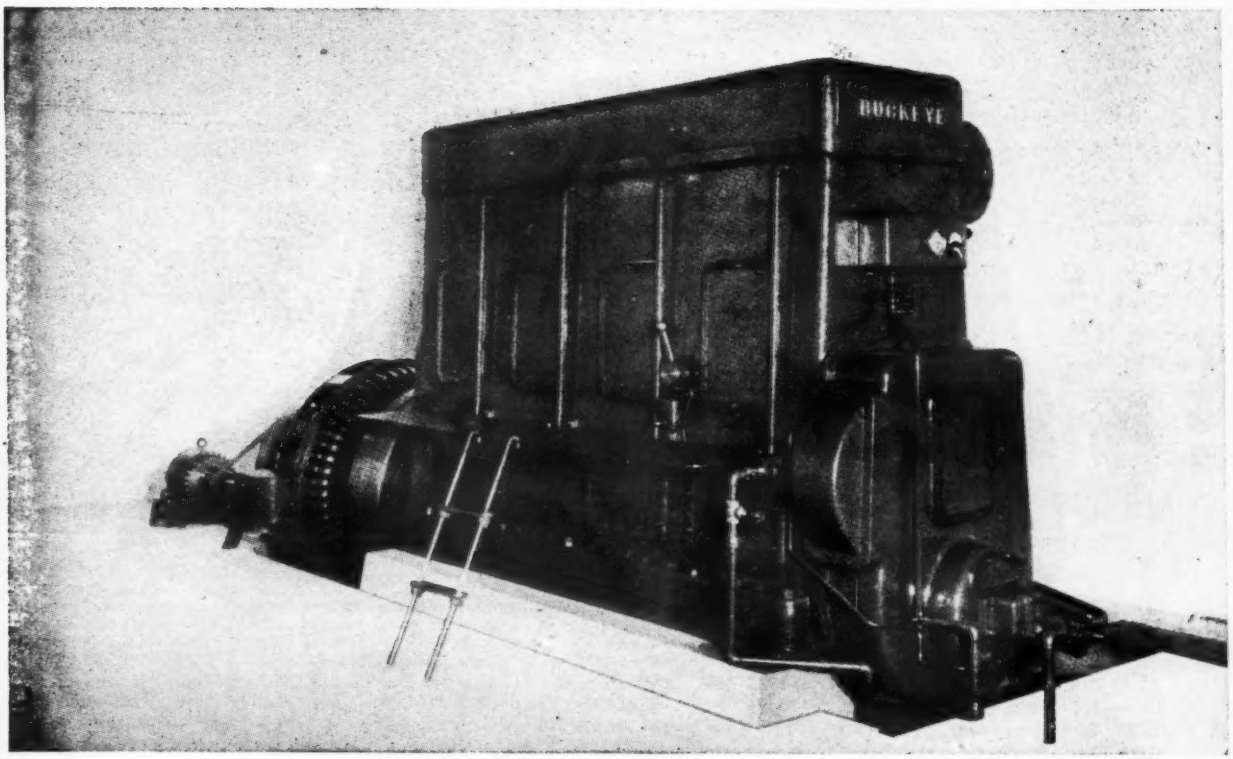
146 GRAND STREET, NEW YORK 13, NEW YORK

Established 1910 **CAnal 6-6976**

BUCKEYE DIESELS

ALWAYS "TOPS" IN YOUR INDUSTRY

IMMEDIATE DELIVERY ON SEVERAL



REBUILT AND GUARANTEED

SEVERAL OTHER IMPORTANT OFFERINGS

Voltage will be corrected to your requirements

750 HP Enterprise	6 cyl	600 KVA	3/60/2400	1938
750 HP Superior	8 cyl	600 KVA	3/60/2400	1933
375 HP Alco	5 cyl	372 KVA	3/60/240	1938
375 HP Fairbanks	5 cyl	300 KVA	3/60/2400	1936
360 HP Fairbanks	6 cyl	300 KVA	3/60/2400	1932
330 HP G. M. Winton	4 cyl	282 KVA	3/60/240	1937
262 HP Buckeye	7 cyl	219 KVA	3/60/2300	1938
225 HP Buckeye	6 cyl	187 KVA	3/60/480	1941
187 HP Buckeye	5 cyl	150 KVA	3/60/240	1937
240 HP Buckeye	3 cyl	187 KVA	3/60/2300	1932
150 HP Buckeye	4 cyl	125 KVA	3/60/480	1939
112 HP Buckeye	3 cyl	94 KVA	3/60/240	1939

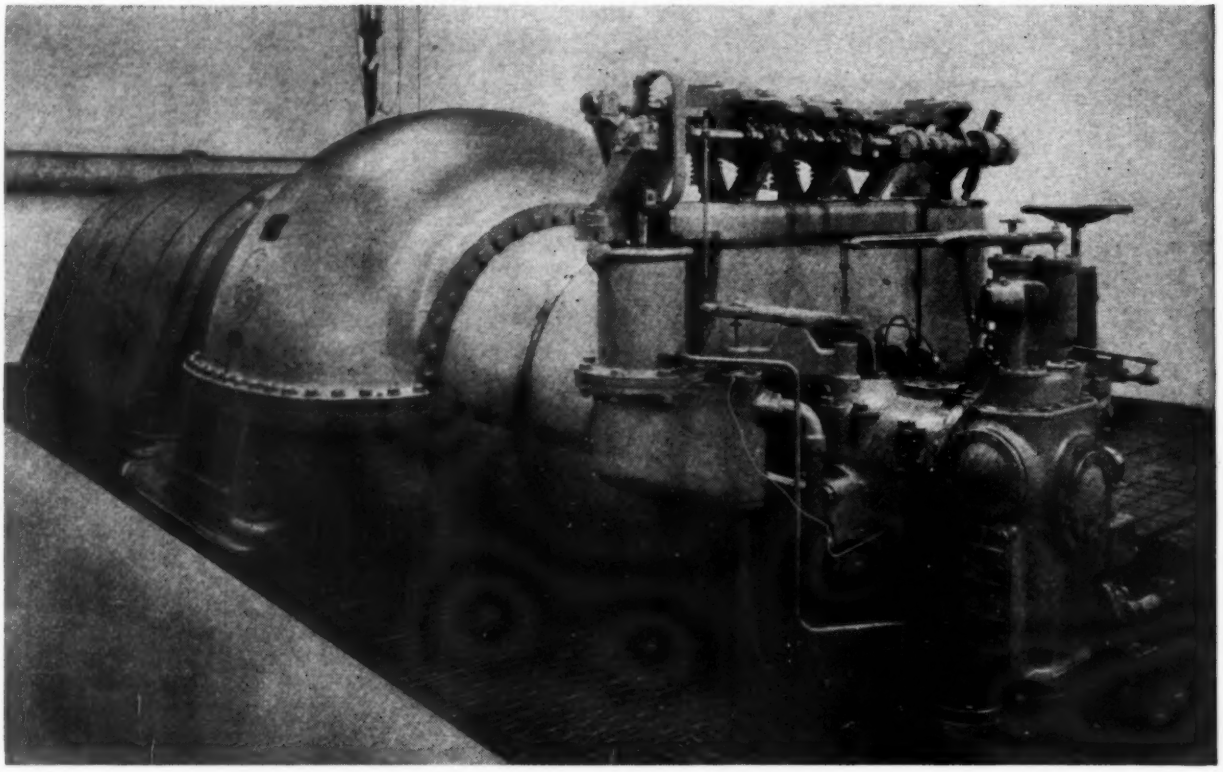
Running Inspection by Appointment.

ROBERT SCHOONMAKER

Port Washington, Long Island, N.Y.

Phone Roslyn 1220

TURBINE GENERATOR UNITS AVAILABLE IMMEDIATE DELIVERY



ACTUAL VIEW

6000 KW 80% P. F. General Electric, 13 stage, form EE, type R, 3600 RPM, 200-400 lbs. pressure direct connected to: 7500 KVA—6000 KW 80% P. F. General Electric, type ATB-2, form HT, 3 phase, 60 cycle, 2300/4000 volt, 3600 RPM alternating current generator equipped with a 9000 sq. ft., two-pass Elliott surface condenser with all condensing auxiliaries, 50 KW, 125 volt direct current steam turbine-exciter set, switchboard panels, instruments and oil circuit breaker—a complete installation. Installed new 1928.

4375 KVA G.E. condensing, 3 phase, 60 cycle, 2300 volts, 3600 RPM, 200# pressure, equipped with condenser and auxiliaries.

3125 KVA G.E. condensing, 3 phase, 60 cycle, 2300 volts, 3600 RPM, 225# pressure, 500° TT, equipped with either a surface or jet condenser, switchboard and instruments.

2500 KVA G.E. 6 stage condensing, 3 phase, 60 cycle, 2300 volts, 1800 RPM, 150–200# pressure, complete with motor driven exciter set, switchboard, C.H. Wheeler surface condenser and condensing auxiliaries.

1875 KVA G.E. condensing, 3 phase, 60 cycle, 6600 volts, 3600 RPM, 200#, 500° TT, complete with condenser.

1875 KVA Westinghouse condensing, 3 phase, 60 cycle, 480 volts, 3600 RPM, 175–200# pressure, 500° TT, complete with turbine driven exciter set, switchboard, Westinghouse jet condenser and condensing auxiliaries.

1875 KVA Elliott condensing, 3 phase, 60 cycle, 2300 volts, 3600 RPM, 300# pressure, 225° F. superheat, complete with shaft exciter, switchboard, condenser and condensing auxiliaries.

1250 KVA Westinghouse condensing, 3 phase, 60 cycle, 2400 volts, 3600 RPM, 200# pressure, equipped with direct connected shaft exciter, condenser, switchboard and instruments.

1250 KVA Westinghouse non-condensing, 3 phase, 60 cycle, 480 volts, 3600 RPM, 200–250#, 500° TT, 15 lbs. gauge back pressure, complete with switchboard panel and instruments.

940 KVA Westinghouse condensing, 3 phase, 60 cycle, 2300 volts, 3600 RPM, 250# pressure, 500° TT, complete with direct connected exciter, surface condenser and auxiliaries.

780 KVA Westinghouse non-condensing, 3 phase, 60 cycle, 480 volts, 3600 RPM, 175–200# pressure, 15 lbs. back pressure, complete.

625 KVA Westinghouse condensing, 3 phase, 60 cycle, 2400 volts, 3600 RPM, 200# pressure, equipped direct connected shaft exciter, condenser, switchboard and instruments.

375 KVA G.E. condensing, 3 phase, 60 cycle, 2300 volts, 3600 RPM, 150–200# pressure, 100° SH, complete with surface condenser.

125 KVA Westinghouse non-condensing, 3 phase, 60 cycle, 240 volts, 3600 RPM, 175–200# pressure, 0–10 lbs. gauge back pressure with direct connected exciter and switchboard.

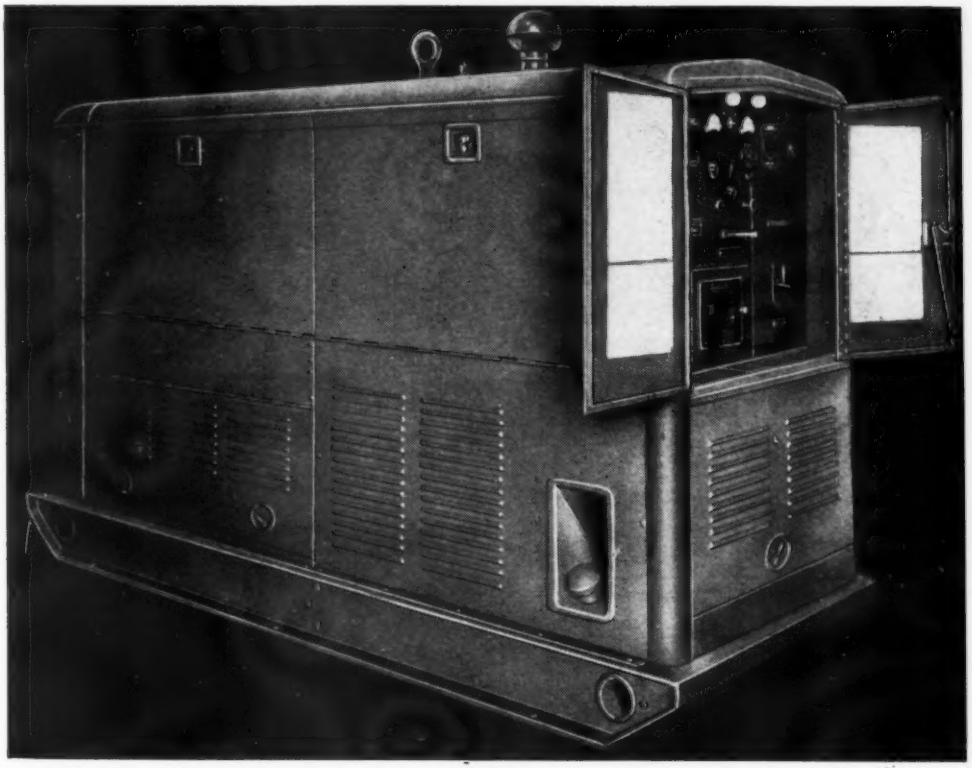
125 KVA G.E. non-condensing, 3 phase, 60 cycle, 240 volts, 3600 RPM, 125#, 10 lbs. gauge back complete with direct connected exciter.

125 KVA G.E. non-condensing, 3 phase, 60 cycle, 2300 volts, 3600 RPM, 150–200# pressure, 10 lbs. gauge back.

100 KVA Westinghouse non-condensing, 3 phase, 60 cycle, 2400 volts, 3600 RPM, 125–200# pressure, 10 lbs. gauge back.

Utilities Electrical Machinery Corporation
600 NATIONAL CITY BANK BLDG.
CLEVELAND 14, OHIO
WIRE OR PHONE
LONG DISTANCE 422

PORTABLE DIESEL GENERATOR SETS



15 KW 30 KW 50 KW

INTERNATIONAL UD-14—UD-18

BRAND NEW—SPOT DELIVERY

RADIATOR COOLED—SKID MOUNTED

60 cycle	127/220 volts
50 cycle	230/400 volts

SPECIAL PURCHASE BARGAIN

ROBERT SCHOONMAKER

Port Washington Long Island, N. Y.

Phone Roslyn 1220

there is a full lifetime of service in— NEW MOTORS

NEW STANDARD OPEN SQUIRREL CAGE 3/60/220-440V. B. B.

Quan.	H.P.	Frame	R.P.M.	Quan.	H.P.	Frame	R.P.M.	Quan.	H.P.	Frame	R.P.M.
5—	1	204	1200	5—	15	326	1800	4—	60	504	1800
18—	1	204	1800	5—	15	365	1200	4—	60	505	1200
5—	1½	204	1800	18—	20	364	1800	2—	75	505	1800
7—	2	224	1800	9—	20	404	1200	1—	75	5084	1200
5—	2	225	1200	18—	25	365	1800	2—	100	5084	1800
6—	3	223	1800	7—	25	404	1200	2—	100	5084	1200
9—	3	254	1200	2—	30	405	1800	7—	125	5085	1800
11—	5	254	1800	8—	30	444	1200	2—	125	6085	1200
12—	5	284	1200	2—	40	444	1800	2—	150	5085	1800
5—	7½	284	1800	2—	40	445	1200	2—	150	6085	1200
12—	7½	324	1200	2—	50	445	1800	2—	200	6085	1800
5—	10	324	1800	3—	50	504	1200	2—	200	6085	1200
5—	10	326	1200								

NEW—TOTALLY ENCLOSED FAN COOLED 3/60/220—440V. B.B.

Quan.	H.P.	Frame	R.P.M.	Quan.	H.P.	Frame	R.P.M.	Quan.	H.P.	Frame	R.P.M.
19—	1	203	1800	5—	10	324	1800	2—	50	445	1800
5—	1	204	1200	5—	10	326	1200	3—	50	504	1800
23—	1½	204	1800	5—	15	326	1800	7—	60	504	1800
5—	1½	204	1200	5—	15	365	1200	7—	60	505	1200
8—	2	224	1800	14—	20	364	1800	2—	75	505	1800
17 —	2	225	1200	14—	20	404	1200	5—	75	508	1200
12—	3	225	1800	9—	25	365	1800	2—	100	508	1800
9—	3	254	1200	7—	25	405	1200	2—	100	508	1200
2—	5	254	1800	6—	30	405	1800	2—	125	6085	1800
5—	5	284	1200	8—	30	444	1200	2—	125	6085	1200
7—	7½	284	1800	3—	40	444	1800	2—	150	6085	1800
12—	7½	324	1200	5—	40	445	1200	2—	150	6085	1200

NEW—D.C. MOTORS 230V.—NEW

2—½ HP, 230 V., Shunt Sl. B, DP, TL204, 690/2760 RPM.
3—½ HP, 230 V., Shunt BB, TE, T-224, 690 RPM.
14—¾ HP, 230 V., Shunt BB, DP, T-225, 690 RPM.
12—¾ HP, 230 V., Shunt BB, DP, T-225, 690 RPM.
4—¾ HP, 230 V., Shunt SL, DP, T-224, 690/2760 RPM.
15—1 HP, 230 V., Shunt BB, DP, T-204, 1150 RPM.
1—1 HP, 230 V., Shunt SL, DP, 204, 1150/2300 RPM.
5—11/2 HP, 230 V., Shunt SL, DP, 224 1150/2300 RPM.
4—11/2 HP, 230 V., Shunt SL, DP, 225, 690/2760 RPM.
16—11/ HP, 230 V., Shunt BB, DP, 204, 1750 RPM.
12—11/ HP, 230 V., Shunt BB, DP, 224 1150 RPM.
19—2 HP, 230 V., Shunt BB, DP, 225, 1150 RPM.
13—2 HP, 230 V., Shunt BB, DP, 224, 1750 RPM.
3—2 HP, 230 V., Shunt SL, DP, 225, 1150/2300 RPM.
5—3 HP, 230 V., Shunt SL, DP, 225, 1150/2300 RPM.
1—3 HP, 230 V., Shunt BB, DP, 225, 1750 RPM.
3—5 HP, 230 V., Shunt BB, 254, 1750 RPM.
1—5 HP, 230 V., Shunt BB, Semi Enc., 254 750 RPM.
1—7½ HP, 230 V., Shunt BB, Open 23-T, 2300 RPM.
1—10 HP, 230 V., Shunt BB, DP, 34-T, 1750 RPM.
1—7½ HP, 230 V., Shunt BB, DP 400/1600 RPM.

NEW STOCK—COMPENSATORS—STOCK NEW

50 HP 220-60-3
75 HP 220-60-3
100 HP 220-60-3
100 HP 220-25-3
125 HP 220-60-3
50 HP 440-60-3
75 HP 440-60-3
100 HP 440-60-3
125 HP 440-60-3
150 HP 440-60-3

NEW—SQUIRREL-CAGE GEAR MOTORS—NEW

¼ HP Master 220/440/60/3 144 RPM
½ HP Bline 220/440/60/3 850 RPM
1 HP GE 220/440/60/3 484 RPM
1½ HP Master 220/440/60/3 350 RPM
1½ HP Master 220/440/60/3 388 RPM
1½ HP Master 220/440/60/3 175 RPM
2 HP Master 220/440/60/3 288 RPM

NEW — DC Specials — NEW

22— 2 KW 215 V 3600 RPM BB
30—100 KW 125-250V 1200 RPM 1 Bearing
1— 20 KW 250 V MG Set 1800 RPM
1— 10 KW Variable Voltage 25-250 V

THE ABOVE SUBJECT TO PRIOR SALE

Guarantees: 1 year by the original manufacturers.

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Electric Motor & Machinery Co.

MONROE 1388-1389 P.O. BOX 1273 ROCHESTER 7, N.Y.
1132-38 MT. HOPE AVE.

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WIDE VARIETY OF FITTINGS STANDARD MAKES!

Large assortment of sizes, pressure classes and flanges to take care of many of industry's needs.

VETERANS: To help you exercise your priority, special veteran service facilities are now available at our offices.

PRICED AT JOBBERS' NET COST WITH FURTHER DISCOUNT OF 15% TO JOBBERS and DEALERS

GATE, GLOBE and PLUG TYPE VALVES IMMEDIATELY AVAILABLE . . . SHIPPED ANYWHERE! STANDARD MAKES including: Walworth, Jenkins Bros., Crane, Lunkenheimer, and others.

Write, wire or phone your requests to the nearest RFC agency listed below for more detailed information. Credit terms can be arranged. If your local office does not have all the materials you need, it will endeavor to locate them from other offices throughout the country.

RECONSTRUCTION FINANCE CORPORATION

A Disposal Agency Designated by the Surplus Property Administration

Agencies located at: Atlanta • Birmingham • Boston • Charlotte • Chicago • Cleveland • Dallas • Denver Detroit • Helena • Houston • Jacksonville • Kansas City, Mo. • Little Rock • Los Angeles • Louisville Minneapolis • Nashville • New Orleans • New York • Oklahoma City • Omaha • Philadelphia Portland, Ore. • Richmond • St. Louis • Salt Lake City • San Antonio • San Francisco • Seattle • Spokane

177-1

REBUILT POWER EQUIPMENT

READY TO SHIP!

SLIPPING MOTORS—3 PH., 60 Cy.

H.P.	Make	Volts	R.P.M.	Type
700	G.E.	2200	393	MT-432
260	Burke	440	600	EMY-65
250	West.	2200	900	CW
200	G.E.	220/440	1200	M-1
150	G.E.	220/440	1200	M-1
75	G.E.	220/440	1200	I
60	West.	220/440	1800	CW
50	Chandeys'n	220/440	1800	
50	West.	220/440	1120	HF
20	Allis Chal.	440	1130	
20	Westg.	220	575	CW
15	West.	220/440	870	CW
15	G.E.	220/440	850	I

ALTERNATING CURRENT MOTORS
3 ph. 60 cy.

H.P.	Make	Volts	R.P.M.	Type
150	Wagner	440	1800	31V
125	G.E.	220/440	1800	I
125	West.	220/440	1800	CS
100	Allis Chal.	220/440	1150	
100	Triumph	220/440	850	B-15
75	Allis Chal.	220	865	
75	West.	220/440	1800	MS
75	Triumph	220/440	685	B-15
60	West.	220/440	1800	CS
60	West.	220/440	1800	CS-T.E.
60	West.	220/440	1200	CS
60	Allis Chal.	220/440	1760	
50 32	G.E.	440	800/640	
50	Chandeys'n	220/440	1800	
50	West.	220/440	870	CS
45	West.	220/440	850	CS
40	West.	220	720	CS
40	West.	220/440	180	CS
30	West.	220/440	1800	MS

VARIABLE SPEED MOTORS—
230 VOLT D.C.

H.P.	Make	R.P.M.	Type
100	West.	300/900	SK-191
75	West.	400/650	SK-181
50	West.	250/750	SK-185A
30	G.E.	450/900	RIC
20	West.	500/1500	SA
20	West.	750/1500	SK-110L
20	West.	625/1250	SA-6
20	Westg.	750/1500	SK-110L
15	Reliance	500/1500	T
15	Reliance	500/1800	
10	West.	400/1600	SA-7
10	G.E.	625/1250	LC
10	Westg.	565/1130	S-6
7½	West.	650/1300	SK-70
5	West.	400/800	SK-80
4	G.E.	850/1700	LC-8
3	G.E.	400/1200	RLC-114
3	Roth	500/1000	RS

SERIES WOUND MOTORS

H.P.	Make	Volts	R.P.M.	Type
175	G.E.	230	475	MD
140	G.E.	230	410	MD
85	Westg.	230	480	MCA 80
80	G.E.	230	500	MD-107
80	West.	230	490	76-A
50	G.E.	230	550	MD-106
50	Cr. Wh.	230	500	8M
35	Westg.	230	550	49D
32	G.E.	230	450	801
32	Shaw	230	485	5L2E
30	Westg.	230	525	MCA 50
28	Westg.	230	395	904
25	West.	230	600	MT
15	West.	230	800	HD
15	Cr. Wh.	220	270	SM
10	West.	230	650	MT-00

230 VOLT DC MOTORS

H.P.	Make	R.P.M.	Type
100	West.	300	8K
100	West.	625	8
85	West.	500	M
80	G.E.	500	MD107
75	G.E.	600	MP
75	G.E.	1500	DT-1121

TRANSFORMERS
1 ph. 60 Cy.

No.	Kva.	Pri.	Sec.	Make
3	250	2300	460/230	Allis Chal.
3	250	6600/5940	2300	West.
2	150	2200/2300/2400	220/230/240	G.E.
3	125	2200	220/440	G.E.
3	112 5	2400	240/480	G.E.
3	100	2400	240/480	Allis Chal.
3	5	2300	220/440	G.E.
3	75	2400–4160Y	240/480	Allis Chal.
1	75	2400–4160Y	120/240	West.
4	75	2400	240/480	G.E.
3	75	2400–4000Y	120/240	Allis Chal.
1	75	2400	240/480	G.E.
2	50	2200/1100	220/110	Maloney
2	50	2200	110/220	Packard
1	40	2300/1150	113/230	Maloney
1	40	1100/2200	110/220	Pittsburgh
3	40	2300/1100	220/110	West.
9	37½	2400	480/240	G.E.
1	25	2300	110/220	West.
2	20	2300/110	440/220/110	West.
1	20	2300	110/230	West.
2	20	1150/2300	115/230	Maloney
6	18	220	19½/38½	El. Furnace
3	15	2200	110/220	Cr. Wh.
3	15	2200	110/220	Packard
21	15	2200/1100	440/220/110	West.
58	7½	2200	110/220	G.E. & West
9	5	2200	110/220	G.E. & West

D.C. CLARK CONTROLLER

1—250 HP Clark Vari time magneto controller 230 v. DC reversing, used for plugging service. Can also be used non-reversing.

MOTOR GENERATOR SETS—
250 & 500 V. D.C.

1—100 KW 720 rpm. 250 v. West. Gen. dir. con. 2200 v. 3 ph. 60 cy. Motor.
2—75 KW 250 v. West. Gens. dir. con. 440 v. 3 ph. 60 cy. AC Motors
2—65 KW 1800 rpm. 250 v. G.E. Gens. dir. con. 220/440 v. 3 ph. 60 cy. AC Motors
1—50 KW 250 v. DC Gen. dir. con. 220/440 v. 3 ph. 60 cy. AC Motor
1—40 KW West. 250 v. DC Gen. dir. con. 220/440 v. 3 ph. 60 cy. AC Motor
1—30 KW 250 v. DC cp.wd. Gen. dir. con. 220/440 v. 3 ph. 60 cy. AC Motor
2—25 KW 250 v. DC West. Gens. dir. con. 220/440 v. 3 ph. 60 cy. Motors
10—Automatic type LO-5 Low Lift Trucks capacity 5 ton, platform type. Equipped with towing coupler and bumper for pushing cars.

WRITE, WIRE OR PHONE YOUR ELECTRICAL NEEDS—SEND FOR STOCK LIST, LIST YOUR IDLE EQUIPMENT WITH US

Duquesne Electric & Mfg. Co. Pittsburgh 6, Pa.

MOTORS • GENERATORS • TRANSFORMERS

MOTORS
3 phase, 25 cycle, 220/440 Volts

HP	Make	Type	Frame	RPM
1	Gen. Elect.	K	224	1450
1	Westinghouse	CS	224	1425
1	Robbins-Myers	H	Ball Bearing	1425
1	Gen. Elect.	KT	926	1345
1½	Louis Allis	ES	Ball Bearing	1430
2	Gen. Elect	KT	731	750
2	Brown & Brockmyer		Enclosed	1450
2	Gen. Elect.	KT	934	1450
2	Gen. Elect.	KT	140	1450
2(3)	Reliance	Enclosed	Ball Bearing	750
2(5)	Westinghouse	T.E.F.C.B.B.	284	500
2(3)	Reliance	Ball Bearing	15AA	750
3	Westinghouse	CS	284	750
3	Allis Chalmers			710
3	Gen. Elect.	KT	180	710
3	Westinghouse	CS	354A	715
3	Wagner	LBP		1420
3(5)	Gen. Elect.	KT	944	1500
3(2)	Cr. Wheeler	T.E.F.C.B.B.	284	750
3	Cr. Wheeler	SC		1500
3	Reliance	Ball Bearing		750
5	Gen. Elect.	KT	180	1500
5	Gen. Elect.	K	284	1450
5	Gen. Elect.	KT	181	750
5	Reliance	Ball Bearing	44AA	750
7½	Lincoln	B. B.	D111	1500
7½	Howell	B. B. R.	326	1500
7½	Ger. Elect.	KF		1450
7½(2)	Gen. Elect.	KT	181	1450
7½	Century	ARS		1450
7½	Wagner			750
10(7)	Wagner	19TBM		710
10	Westinghouse	CS		710
10	Reliance			750
10(2)	Gen. Elect.	KT	312	750
10(5)	Gen. Elect.	KT	512	750
10(3)	Westinghouse	Enclosed	Gear Head	1500/378
15	Gen. Elect	KT	327	750
15	Westinghouse	MS		750
15(3)	Westinghouse	CCL		750
15	Westinghouse	CCL		1500
15	Master	Enclosed	Gear Head	1500/416
20	Westinghouse	CS		730
20(3)	Westinghouse	CCL		750
20	Wagner	BP22T		750
25	Gen. Elect.	I	Form K	750
30	Burke			750
30	Gen. Elect.	I	Form K	750
30	Wagner			750
40	Wagner	22TLBP		1500
40	Gen. Elect.	KT	347	750
50	Gen. Elect.	I	Form K	750
75(4)	Gen. Elect.	I	Form K	500
75(2)	Gen. Elect.	KT	557	750
75	Westinghouse	CS		750
100	Westinghouse	CCL		500
150	Gen. Elect.	I	Form K	375
150	Gen. Elect.	KT	568	375
150	Gen. Elect.	KT	557Y (2200 v.)	1470
200	Gen. Elect.	I	Form K	500
225	Elect. Mach.	Synch.	(2200 v.)	500
250	Gen. Elect.	KT	568	750

TRANSFORMERS

3— 75 KVA Niagara. New. OISC 60/1/2400/120/240.
6—100 KVA Niagara. New. OISC 60/1/2400/120/240.
3—150 KVA Westinghouse OISC 25/1/2300/460.
3—200 KVA Westingnouse OISC 25/1/2300/460.
3—500 KVA Pittsburgh OISC 25/1/2300/230/460.

MOTORS
3 phase, 60 cycle, 220/440 Volts

HP	Make	Type	RPM	Serial No.
15	Westinghouse	CS	1200	1883285
15	Westinghouse	MS	1200	9445931
20	Westinghouse	CS	1200	2160500
20	Westinghouse	MS	1200	1050826
20	Westinghouse	CS	1800	1843526
20	Westinghouse	CS	1800	2695044
25	Westinghouse	MS	1800	1562026
25	Westinghouse	MS	1800	1334763
25	Westinghouse	CS	1200	2286768
25	Westinghouse	MS	1200	1197673
25	Wagner	BP	1200	126906
30	Westinghouse	MS	1200	1197674
30	Fairbanks-Morse	V-H-10D	1800	43476
40	Westinghouse	CS	900	1896969
40	General Electric	I-K	1800	73318
40	Westinghouse	MS	1800	1506800
40	General Electric	I-K	1200	181444
40	Westinghouse	MS	1200	1027421
50	Westinghouse	MS	1800	1289389
50	Westinghouse	MS	1200	854410
50	Westinghouse	CS	1800	2691183
50	General Electric	14	1800	181444
50	General Electric	KT-352	720	
50	Allis Chalmers		1800	3K28825
60	Reliance		1200	B11458
60	General Electric	I	1800	292596
60	Westinghouse	CCL	1800	329654
60	Robbins-Myers	K	1800	P515362
60	Triumph		1800	C14248
60	Westinghouse	CCL	1200	854121
				(2200 v.)
100	Westinghouse	CCL	1800	1043213
100	Westinghouse	CCL	1800	765231
				(2200 v.)
125	Westinghouse	CS	1200	2318625
150	General Electric	KT568	450	
150	Westinghouse	CS	1800	2429726
150	Westinghouse	CCL	900	438385
150	Westinghouse	CS	1200	4572596
				(2200 v.)
150	General Electric	I-K	1200	
150	Westinghouse	CCL	720	808349
				(2200 v.)
200	General Electric	KT568	514	
200	General Electric	I-K	900	232917
				(2200 v.)
200	Westinghouse	CCL	900	919537
				(2200 v.)
250	General Electric	KT568	600	
250	General Electric	I-K	600	2246834
300	General Electric	KT568	720	
300	General Electric	I-K	720	2357743
400	General Electric	I-K	900	2347845
400	General Electric	KT568	900	

SLIP RING MOTORS
3 phase, 60 cycle, 220/440 Volts

HP	Make	Type	RPM	Serial No.
20	Westinghouse	CW644C	675	8009992
20	General Electric	MT332	545	3889010
30	Westinghouse	HF	1745	4558408
40	Westinghouse	CW748	690	4406823
250	Allis Chalmers	3 bearing	505	104390
				(2300 v.)
400	General Electric	I-M	900	224674
400	General Electric	I-M	900	246762

MAGNETIC CONTACTOR

400 HP. Gen. Elec. Type CR 7006. Form D12D. 3/60/440 Volts.

25 CYCLE GEARHEAD MOTORS

3—10 HP. Westinghouse Frame. 364. Enclosed 1500/378 RPM.
15 HP. Master Frame 405 Enclosed 1400/416 RPM.

WELDERS

1—300 AMP. Lincoln Shield Arc—60 cycle.
1—400 AMP. Lincoln Shield Arc—25 cycle.

SPECIAL

10—5 HP. Westinghouse Motors Nema Frame CSW. 284—Totally Enc., Fan Cooled Ball Bearing 3/60/220/440 volts, 1200 RPM.

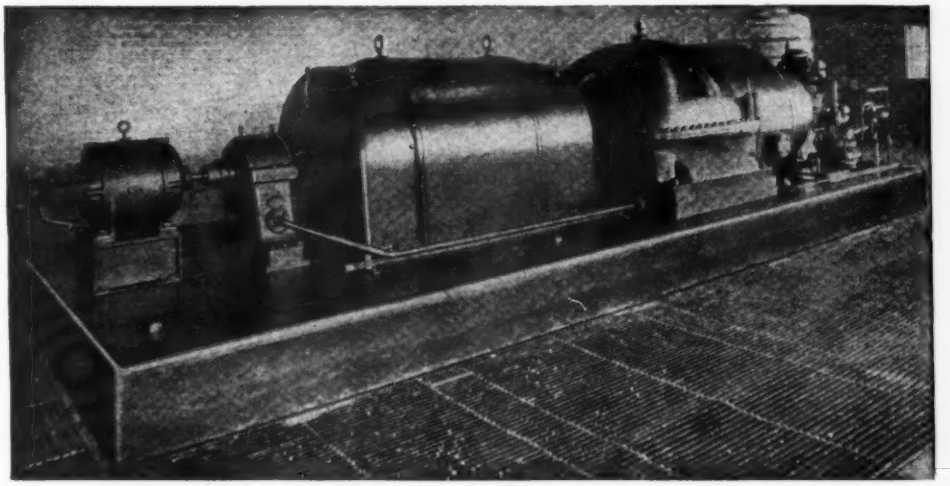
FREQUENCY CHANGER

450 KVA. Westinghouse Synch. Generator, 25 cycle, 3 phase, 440 volts, 720 RPM., direct connected to 850 HP. West. Synch. Motor 60 cycle, 3 phase, 4160 volts, 720 RPM. With starting equipment and panels.

ERIE ELECTRIC CO., INC.

124 CHURCH ST. BUFFALO, N. Y.
CL. 4758

TURBO-GENERATORS



Units Noted Below Are Now In Our Stock—All Are 3 Phase, 60-Cycle, 3600-RPM

7500—KVA. G.E. Sur. Cond., 190/375#: 2300-v.
6250—KVA. G.E. Sur. Cond., 200, 2300#-v.
5000 KVA. G.E., Sur. Cond., 200/400#: 2300/4000-v.
3750—KVA. G.E. Sur. Cond., 200#, 2300-v.
3125—KVA. G.E. Sur. Cond., 200#, 2300-v.
2500—KVA. G.E. Sur. Cond., 200#, 2300-v.
2000—KVA. G.E., Non-cond. 200#, 2300-v.
1875—KVA. G.E., COND. 200#.
1875—KVA. Elliott 300#-G, 2300-v.
1565—KVA. G.E. Sur. Cond. 150#, 2300
1250—KVA. Westinghouse, 200#, 2300-v.
1250—KVA. Allis-C. Non-cond. 150#, 840-v.
1250—KVA. West. Sur. Cond. 200#, 2300
1250—KVA. Allis-C. Non-cond. 150#, 480-v.
937—KVA. Allis-C. Cond. 200#.
937—KVA. G.E., 200#, Cond. 2300-v.
625—KVA. G.E., 200#, 2300-v.
375—KVA. G.E., Cond. 200#, 2300-v.

WILMS, WEAVER & CO.

Steam Turbine-Generator Specialists

4045 Penobscot Building **Detroit (26) Michigan**

75' x 140' Steel Building—4 yrs. old
155 HP Heine ASME WT Boiler, 175# P.
25" x 40" Jaw Crusher with Feeder & Motor
210 HP F-M Diesel Engine—Generator Set
150 KW, 220/3/60/Gen. dir. con. 4-Val. Eng.
75 & 50 KVA AC Gens, dir. con. Steam Engines
¾ & ½ Yd. Shovels—Gas & Electric
VOLTAGE REGULATORS — Burlington, Prompt Del.

H. & P. MACHINERY CO.
6719 Etzel Ave., St. Louis 14, Mo.

APPLICATION ENGINEERS

50 KW—M. G. Syn. Set—440 AC to 250 DC.
500 KW—Westinghouse 240 V. Non-cond. turbine.
96 KW—240 Volt AC uniflow engine set.
375 KVA—480 Volt Ball 4-Valve engine set.
187 KVA—240 Volt Chuse 4-Valve engine set.
120 HP Fairbanks Morse Diesel engine.
List surplus equipment with us.

HOWARD B. JOHNSON & ASSOCIATES
53 W. Jackson Blvd. Chicago 4, Ill.

DIESEL GENERATOR UNIT

1500 H.P.—1250 KVA
Nelseco — General Electric
Modern, Supercharged, Bosch Injection
3/60/2400, 300 RPM, All Accessories, Complete
Immediate Stock Delivery Rebuilt

A. G. SCHOONMAKER COMPANY
50 Church St., New York 7, N. Y.
Phone Worth 2-0455

POWER PLANT EQUIPMENT CO., Inc.

39 Cortlandt Street
New York, N. Y.

A.C. TURBINE UNITS

5000 KVA GE 2300/4000 v. (bleeder)
3750 KVA GE 2300 v. Cond.
1560 KVA Wghse 480 v. (bleeder)
1556 KVA Al. Chal. 2300 v. Cond.
1250 KVA G.E. 2300 v. (Bleeder)
937 KVA G.E. 2300 v. Cond.
750 KVA G.E. 2300 v. Cond.
625 KVA Wghse. 480 v. (bleeder)
625 KVA G.E. 2300 v. Cond.
625 KVA Ridge. 400 v. Non-Cond.
375 KVA G.E. 480 v. Cond.
375 KVA G.E. 2300 v. Non-Cond.
50 KVA Terry 480 v. Non-Cond.

UNIFLOW UNITS

750 KVA G.E.-Filer Stowell
625 KVA Skinner Uniflow
350 KVA G.E.-Ames
312 KVA G.E. Chuse Uniflow
180 KVA W.E.-Chuse 4 v.
166 KVA Al. Chal.-Ames

W. T. BOILERS

1047 HP. (2) Heine 250#
759 HP. (2) Sterling 250#
612 HP. Sterling 200#
403 HP. Sterling 250#
365 HP Kidwell, 200#
317 HP. (2) Heine 250#
310 HP (2) Union, 175#, cr. dr.
260 HP. Kidwell 207#
118 HP B & W 160#

DIESEL ENGINE UNITS

1500 KVA Wghse.-Am. Loco.
737 KVA Wghse.-Am. Loco.
375 KVA G.E. (2)-Worthington
225 KVA W.E.-Worthington
125 KVA W.E.-Worthington

SYNCHRONUOUS CONDENSER

500 KVA G.E. 4150/2300 v.

PUMPS (MOTOR DRIVEN)

1000 GP. Al. Chal. 246' hd.
800 GPM Al. Chal. 325' head

AIR COMPRESSOR

3000 CFM Sullivan 125#; with 500 HP Motor

CHICAGO'S LARGEST STOCK GUARANTEED EQUIPMENT

MOTOR-GENERATOR SETS

KW	Make	DC	Volts	AC Volts
1000	Wtg.	275	Ind.	3/60/4100
750	Elliott	275	Syn.	3/60/440
500	G.E.	600	Syn.	3/60/2300
400	G.E.	275	Syn.	3/60/2300
300	G.E.	250	Syn.	3/60/480
300	G.E.	275	Syn.	3/60/2200
225	Ideal	115	Syn.	3/60/2200
100	G.E.	3 wire	Syn.	3/60/480
75	G.E.	125	Ind.	3/25/220
75	G.E.	125	Ind.	3/25/440
90	Wtg.	110	75 KVA	3/60/2300
60	Al. Ch.	110	Ind.	3/60/2300
50	G.E.	115	Ind.	3/60/440
35	G.E.	250	Ind.	3/60/220
35	Century	240	Syn.	3/60/240

SLIPRING MOTORS

3 phase, 60 cycle

HP	Make	Type	Volts	Speed
800	Wtg.	CW	6600	507
600	Al. Ch.	ANY	2200	1180
600	Wtg.	CW	2300	343
350	Wtg.	CW	220	700
300	G.E.	IM	2200	514
300	G.E.	MT	2000	450
200	F. Morse		440	600
300	Al. Ch.		440	705
250	G.E.	IM	440	720
250	G.E.	IM	2200	600
200	Ideal	AV	440	600
150	Al. Ch.	ARY	440	880
150	Wtg.	CW	440	600
100	G.E.	IM	2200	1800
100	Wtg. vert.	CW	2200	1160
100	Ideal	AV	2200/440	720
100	Westg.	HF	440	230
75	G.E.	MT	220	1800
50	G.E.	MT	440	1800
50	G.E.	IM	220	900
50	Al. Ch.	ARY	220	690
50	G.E.	MT	2200	600
50	Wtg.	CW	440	570
40	Wagner	TBR	440	1750
40	Al. Ch.	ARY	220	1160
30	G.E.	MT	440	1150
30	Wtg.	CW	220	865
35	G.E.	IM	220	1140
25	G.E.	IM	220	855

SQUIRREL CAGE MOTORS

3 phase, 60 cycle

HP	Make	Type	Volts	Speed
350	G.E.	KT	440	1765
150	G.E.	I-K	440	1800
150	G.E.	I-K	3b	600
100	G.E.	KT	440	3450
150	Wtg.	CS	2200	720
150	Al. Ch.		440	570
150	G.E.	IK	440	575
100	Wtg.	CS	2200	1750
100	Wtg.	CS	440	900
100	Wtg.	CS	2200	870
75	G.E.	KT	2200	1800
75(9)	Al. Ch.	AR	2200	1765
75	Westg.	CS	2200	870
75	G.F.	KT	440	870
75	Wtg.	CS	220	600
60	G.E.	KT	440	865
60	Wtg.	CS	220	435
60	Wtg.vert.	CS	2200	1750
50	G.E.	KT	440	900
50	G.E.	IK	440	1200
40	G.E.	KF	2200	1745
40	G.E.	KT	220	1745
40	Wtg.	C	440	850
40	Al. Ch.		440	850
40	F. Morse	H	2200/440	720
40	Al. Ch.		440	570
40	Comm.	W584	440	600
35	G.E.	IK	440	1200
35	Wtg.	CS	2200	1175
35	G.E.	KT	220	900
35	G.E.		2200	900
35	Al. Ch.		440	680
30	G.E.	KF405 t.e.f.r.	220	1760
35	Al. Ch.		440	480
30	G.E.	KT	220	880
30	G.E.	KT	440	900
30(2)	Wtg.	CCL	220	840
30(2)	Al. Ch.		640	860
30	US	SC	200	1800
30	G.E.	KT	220	600
25	Ideal	AA80	220	1740
25	Cr. Wh.	118Q	440	1150
20	G.E.	KF364	220	1760

This is a partial listing only, have NEW from ¼ to 75 hp right in stock.

A. C. GENERATORS

KW	Make	Volts		Speed
300	G.E.	480		900
200	Westg.	2400		900
75	Burke	AC16	240	1200
75	G.E.	ATB	230	1200
72	F. Morse	AB	440	900
60	F. Morse	D	2300	300
8	G.E.	ATI	240	900

TRANSFORMERS

KVS	Make	Pri. V.	Sec. v.
2— 667	Maloney	13200	460
2— 500	G.E.	33000	480
1— 100	G.E. 2 ph.	9000	230
3— 75	Wtg.	3810	244/122
2— 50	G.E.	2200	440/220
1— 20	G.E.	2200	220/440
1— 15	G.E.	1050/2100	2200/.88
1— 15	G.E.	2400	120/240
1— 7½	G.E. 3 ph.	2200/3810	220/440
1— 7½	G.E.	1100/2200	220/440
1— 6	Kuhlman	100	20
1— 5	Sorgel	140	220
1— 5	G.E.	1100/2200	110/440
1— 5	G.E.	1100/2200	220/440
5— 3	G.E.	440	110/55
1— 3	Maloney	1150	115/230

Also New. All Kinds

BOILERS

2—800 "Twin setting" B & W Stirling ASME, 200 lbs. all complete, excellent condition.

2—400 hp. Casey Hedges, water tube Boilers, oil burning, 150 lbs.

FREQUENCY CHANGER

1—1400 HP General Electric type ATI-24-1250M-300, form C, 3 ph. 60 cy. 460 volt, 300 RPM, 1570 amps, 1250 KVA, 0.9 P.F. 50° synchronous motor with amort. wdg.; dir/conn. to 1000 KW General Electric type ATI-16-1250M-300, 3 ph. 25 cy. 460 volts, 300 RPM, 1570 amps, 1250 KVA, 0.8 P.F. 50° A.C. generator with amort. wdg., with 33 KW G.E. 125 volt direct connected exciter. (This is a three brg. unit suitable for operation from either end.)

SYNCHRONOUS MOTORS

3 phase, 60 cycle

HP	Make	Type	Volts	Speed
1000	Wtg.		440	900
750	Al. Ch.		440	1200
750	G.E.	conds.	550	900
500	G.E.	TS	2300	450
300	G.E.	conds.	480	900
270	G.E.	ATI	440	600
150	Burke	S1375	2200	600
100	Cr. Wh.		240	900
50	El. M.	.8	240	1200
10	G.E.	ATI	240	900
5	G.E.	K324 reluctance type	220	1800

VARIABLE SPEED D. C. Motors

HP	Make	Type	Speed
100	G.E.	C	1100/1200
25	Wtg.	S9	550/780
25	G.E.	DLC	500/1000
20	Wtg.	SK113	500/1000 (4)
15	G.E.	RC16	500/700
15	G.E.	CE	650/950
14	G.E.	C	700/1400
12	Wtg.	SK80L	500/1000 (2)
10	El. Dyn.		600/1200
12½	G.E.	C	700/1400
4	G.E.	C	800/1400
5	Burke	AM12	500/1500
5	Burke	WAM12	650/1950

WE ARE ALWAYS IN THE MARKET FOR ALL TYPES OF GOOD MODERN ELECTRIC MOTORS, MOTOR - GENERATOR SETS GENERATORS, TRANSFORMERS, AND OTHER ELECTRICAL EQUIPMENT. SEND US YOUR LISTS FOR BEST CASH OFFERS.

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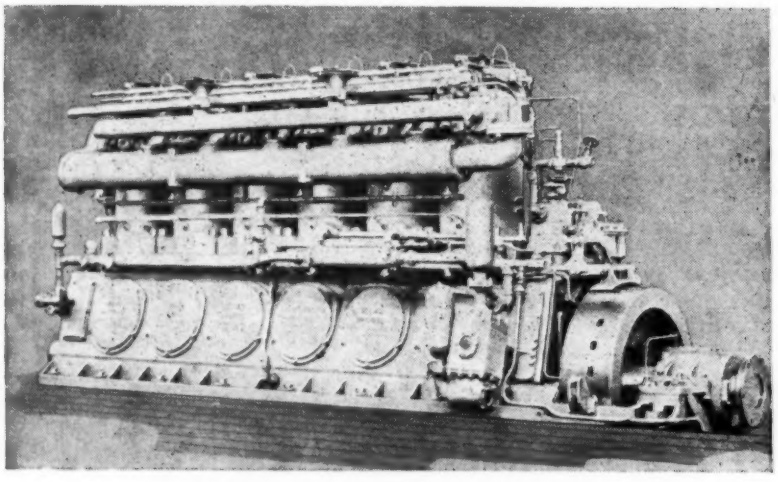

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TURBINE UNITS—60 Cy.

1—22500 KW General Electric Cond.
1—15300 KVA Westinghouse Cond.
1— 7500 KVA General Electric Cond.
1— 5000 KVA General Electric Cond.
1— 3750 KVA Westinghouse Extrac.
1— 3125 KVA Westinghouse Cond.
1— 2500 KVA General Electric Cond.
1— 1563 KVA General Electric Cond.
1— 1563 KVA Westinghouse Extrac.
1— 1250 KVA General Electric Extrac.
1— 625 KVA General Electric Cond.
2— 625 KVA General Electric Non-C.

D. C. TURBO UNITS

1—125 KW General Electric, 125 V.
1— 75 KW General Electric, 125 V.

STEAM ENGINE UNITS—60 Cy.

1—625 KVA Ames Uniflow
2—480 KVA Skinner Uniflow
1—375 KVA Harrisburg Uniflow
1—325 KVA Skinner Uniflow
1—300 KVA Skinner Uniflow
1—150 KVA Ames Uniflow

D. C. STEAM ENGINE UNITS

1—500 KW Ames Uniflow 250 V.
1—400 KW Ridgway 4-valve 275 V.
1—350 KW Ridgway Uniflow 250 V.
1—300 KW Skinner Uniflow 275 V.
1—125 KW Ridgway 4-valve 250 V. 3-wire

DIESEL ENGINE UNITS

1—1400 HP Fair.-Morse, 2300 V. 60 cy. gen
3— 700 HP Enterprise, 2400 V. 60 cy. gen.
1— 625 HP Worthington, 240 V. 60 cy. gen.
2— 450 HP Worthington, 2300 V. 60 cy. gen.
1— 440 HP Nordberg, 250 V. DC gen.
2— 400 HP LeRoi RXISV (gasoline) eng. only
1— 375 HP McInt. & Sey., 240 V. 60 cy. gen.
1— 300 HP McInt. & Sey., 480 V. 60 cy. gen.
1— 150 HP Buckeye 400 RPM engine only
2— 125 HP Winton, 240 V. 60 cy. gen.

WATER TUBE BOILERS

4—1373 HP B. & W. 230-lb., Oil Fired
1—1302 HP Springfield 400-lb., Pulverizer
2— 760 HP Stirling 250-lb., Stokers
2— 617 HP Wickes 250-lb., Bent Tube
1— 607 HP Wickes 250-lb., Stoker
6— 600 HP B. & W. 200-lb., Stokers
2— 600 HP Springfield 200-lb., Stokers
2— 560 HP Erie City 460-lb.
2— 481 HP Springfield 225-lb., Pulverizer
2— 405 HP Erie City 160-lb., Stokers

SYNCHRONOUS MOTORS

1—600 HP G. E. 60 cy. 2200 V. 600 RPM
1—500 HP Al.Ch. 60 cy. 2300 V. 450 RPM
1—375 HP G. E. 60 cy. 2300 V. 1800 RPM
2—250 HP G. E. 60 cy. 2200 V. 225 RPM
1—200 HP Ideal 60 cy. 4000 V. 514 RPM
1—100 HP G. E. 60 cy. 2300 V. 240 RPM (Super)

INDUCTION MOTORS—60 Cy.

1—2500 HP G. E. slip ring 6600 V. 253 RPM
1—1000 HP West. slip ring 2200 V. 360 RPM
1— 300 HP West. slip ring 440 V. 1200 RPM
1— 150 HP G. E. slip ring 440 V. 450 RPM
2— 100 HP G. E. sq. cage 440 V. 720 RPM

MOTOR GEN. SETS—60 Cy.

1—1000 KW General Electric 600 V. DC
1— 300 KW Westinghouse 600 V. DC
1— 150 KW General Electric 125 V. DC
1— 100 KW Westinghouse 125 V. DC
1— 75 KW General Electric 125 V. DC

ROTARIES—60 Cy.

2—2600 KW General Electric 300 V.
1—2000 KW General Electric 600 V.
2—1750 KW General Electric 250 V.
1—1500 KW Westinghouse 250 V.
2—1000 KW Westinghouse 250 V.
1— 500 KW General Electric 250 V.

FREQUENCY CHANGERS

2—12500 KW G. E. 60/25 cy. 300 RPM
2— 3125 KVA West. 25/62½ cy. 750 RPM
1— 1875 KVA G. E. 25/60 cy. 300 RPM
1— 1500 KW West. 25/60 cy. 300 RPM
1— 1000 KVA Al.Ch. 25/62½ cy. 375 RPM

TRANSFORMERS—1 Ph. 60 Cy.

4— 500 KVA West 110,000-2300 V.
4— 6667 KVA G.E. 79660/138,000-34500 V.
3— 3333 KVA Moloney 66000/33000-13200 V.
1— 1500 KVA Pitts. 66000-33000 V. 3 ph.
3— 750 KVA Pitts. 66000-33000 V.
3— 100 KVA G.E. 66000-6900/11000 V.
3— 1667 KVA G.E. 44000-2300/4000 Y V.
3— 1000 KVA G.E. 44000/22000-480 V.
1— 7500 KVA West. 33000-13800 V. 3 ph.
3— 200 KVA G.E. 33000-2300/4000 Y V.
3— 150 KVA G.E. 33000-2300 V.
14— 75 KVA G.E. 33000-2400 V. New
48— 50 KVA G.E. 33000-2400 V. New
50— 25 KVA G.E. 33000-2400 V. New
2—10000 KVA West. 26400-4560 V. ph.
1— 6000 KVA West. 26400-2300 V. 3 ph.
4— 400 KVA Pitts. 22000/11000-2200 V.
3— 200 KVA G.E. 22000-250/480 V.
1—10000 KVA West. 13200-4560 V. 3 ph.
3— 1667 KVA Pitts. 13200-2300 V.
4— 1250 KVA Pitts. 13500-230/460 V.
3— 200 KVA G.E. 13200-480 V. Pyranol
3— 100 KVA West. 13200-2300 V.
3— 150 KVA G.E. 4150-220 V. 3 ph.

OIL CIRCUIT BREAKERS

2—1000 A. 30 KV Kelman CB76	Outdoor
1— 400 A. 25 KV G.E. FK0136	Outdoor
2— 600 A. 15 KV G.E. FK037	Outdoor
1— 600 A. 15 KV West. 0-221	Outdoor
2— 400 A. 15 KV G.E. FHK0136	Outdoor
3— 400 A. 7.5 KV G.E. FK0227	Outdoor
2—1200 A. 7.5 KV G.E. FK132B	Indoor

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500 KW AL-CH. 250 D.C. 2300/4000 A.C. 1200 RPM
300 KW G.E. 600 D.C. 2300/4000 A.C. 1200 RPM
200 KW G.E. 250 D.C. 2300/4000 A.C. 1200 RPM
150 KW WEST. 250 D.C. 2300/4000 A.C. 1200 RPM

MOTOR GENERATORS

300 KW G.E. SYN. 600 V. 2300/4000 A.C. 1200 RPM
300 KW WEST. SYN. 250 V. 4000/6600 AC. 900 RPM
150 KW WEST. SYN. 600 V. 2300/4000 AC. 1200 RPM

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1—6000 KW. G.E. 2300/4000
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1—1500 KW. 2300 V. Cond.
1— 750 KW. 2300 V. Cond.
1— 750 KW. 600 V. Cond.
1— 500 KW. 550 V. Cond.
1— 500 KW. 440 V. Non. C.
1— 500 KW. 125 V. D.C.
1— 375 KW. 440 V. Cond.
1— 120 KW. 440 V. Non. C.

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1—168 KW. 550 V.
2—280 KW. 440 V.
1—600 KW. 2300 V.
1— 75 KW. Uniflow 240 V.

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1—375 H.P. with gears
1—210 H.P. Terry 250#
1—100 H.P. G.E. with gears

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1—1390 H.P. 400# Coal
2— 480 H.P. 225# Coal
1— 360 H.P. 190# Coal
2— 300 H.P. 250# Coal
1— 260 H.P. 200# Coal
2— 175 H.P. 200# Oil
4— 150 H.P. 150# H.R.T.
2— 100 H.P. 135# Coal
1— 70 H.P. Ames Ecom.

MOTOR

1—1250 H. P. G.E. Syn. Engine Type 2300 V.

AIR COMPRESSORS

1—6700 C.F. 22# Turbine Driven
1—1600 C.F. 50# Steam
1—860, C.F. 50# Diesel
1—1247 C.F. 55# Motor
1—1214 C.F. 100# Motor
1—600 C.F. 350# Steam
2—136 C.F. 100# Belted

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1—3100 Sq. Ft. Worth.
1—1485 Sq. Ft. Wheeler.

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SLIP RING MOTORS
3-PH., 60 CY.

HP	Volts	Make	Speed
900	2300	G.E.	900
500	2300	G.E.	900
400	2300/440	Whse.	400
400	2300/440	G.E.	600
350	2300/440	G.E.	600
300	440	Al. Chal.	900
300	2200/440	G.E.	600
300	2200	G.E.	1800
250	2300	G.E.	600
250	440/550	G.E.	600
200	2200/440	G.E.	600
150	2300	G.E.	450
150	2200/440	G.E.	600
125	440/220	G.E.	1200
125	440/220	G.E. (Hoist)	900
100	220/440	G.E.	720
100	440/220	G.E. MTC	900
100	550	G.E.	900
100	2200	G.E.	900
100	2200	G.E.	1800
75	2200	Al. Chal. (new)	900
75	440/220	G.E. (MTC)	600
75	2200/440	G.E.	1200
50	2200/440	G.E.	600
75	550	G.E.	900
60	2200	G.E.	900
40	2200	Whse.	900
40	2200	G.E.	1200

SYNCHRONOUS MOTORS
3-PH., 60 CY.

300	440/220	Al. Ch.	600
200	2200	Whse.	900
110	440	Whse.	900
100	2200/550	Al. Ch.	1800
100	440/220	G.E.	360
75	440/220	G.E.	720

OUTDOOR OIL CIRCUIT BREAKERS

1—New 400 Amp. Type FK, 134-1328A, General Elec. 3PST, 25,000 Volt Oil Switch, Interrupting Capacity 125,000 KVA, complete CT's PT's, etc.
3—NEW 400 amp., Type FKO 227, G. E., 7500 V., outdoor type, hand-operated.
1—3000 ampere, type FK 25, General Electric, 3 pst, 600 volt.

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60 CYCLE

4—1250 kva, Al. Chal., 13800-460/230 V.
3— 833 kva. Whse., 11000-2300 V.
3— 500 kva, G.E., type H, form K8, 13800-230/460.
3— 333 kva., G.E., 66000-480 V.
1— 300 kva., Whse., 3 Ph., 13800-230 V.
2— 250 kva., Whse., 13,800-460.
3— 200 kva., Whse., 11000Y-2300 V.
3— 200 kva., G.E., 13200-480 V.
6— 200 kva., G.E., NEW PYRANOL, 2300-450 V.
2— 150 kva., G.E., type HTQ, 4150-240/480 V.
3— 150 kva., G.E., H-KDD 13200-2300.
3— 150 kva., G.E., H-KS, 2400-240/120 V.
3— 100 kva., G.E., type H 2400-240-480.
3— 100 kva., G.E., type H-KDD, 6900/11950V-230/115.
3— 100 kva., G.E., type H-KR 6600/11430V-2300 V.
3— 100 kva., G.E., H-KDD, 6600/11950-230/115 V.
3— 100 kva., G.E., H-KS, 2400-240/480 V.

TURBO-GENERATOR SET

1—112½ kva., 1200 rpm., 220/440 v., 3 ph., 60 cy., G.E., conn. to Terry, 3600 rpm., non-cond. turbine, 100/150 lbs. gu.

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
500	440/220	G	IK	1200
500	440/220	G.E.	IK	900
400	2200/440	Whse.	CS	720
300	440	Whse.	CS	450
250	2200/440	G.E.	IK	600
250	2200	G.E.	IK	450
200	440/220	G.E.	IK	1200
150	440/220	G.E.	KT	720
150(3)	440/220	G.E.	KT	1200
125	440	G.E.	K	514
125	440/220	G.E.	KT	1800
125	440/220	G.E.	KT (Vert.)	1800
100	440	G.E.	IK	450
100	2200	G.E.	KT	1800
100	440	Whse.	CS	1200
100	550	Cr. Wh.		720
100	550	G.E.	KT	900
74	2200	G.E.	KT	900
50	2200	Al. Chal.		720

MOTOR GENERATOR SETS

1—75 KW, 250 V, 850 RPM, conn. to 110 HP, 440/230 V. Sq. Cage Motor.
1—50 KW, 250 V. 850 RPM, Whse. conn. to 75 HP. 440/220 V. 3 ph. 60 cy. Sq. Cage Motor.
1—50 KW, 125 V., 1200 RPM, Whse. conn. to 75 H.P. 2200/220 V.; 3 ph., 60 cy., Sq. Cage Motor
1—35 KW, 125 V., 1800 RPM., G.E., conn. to 50 HP., 440/220 V., 60 cy., squirrel cage.

A.C. GENERATORS

1—375 kva, 514 rpm,480/240 V. G.E.
1—250 kva, 600 rpm, 440/220 V. Al. Ch.
1—200 KVA, 600 RPM, 4150/2300 V., Cr. Wh.
1— 96 kva, 360 rpm. 480/240 V. G.E.

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Several 450 lb. Boilers Available
2—1400 H.P. B. & W. 225-lb. Boilers
2—1060 H.P. Heine Boiler 200#
2— 825 H.P. B. & W. Sterling Boilers 200#
2— 750 H.P. Edge Moor 200# Boilers
3— 600 H.P. B. & W. 200# Boilers
2— 600 H.P. Edge Moor 200# Stokers
2— 440 H.P. B. & W. Sectional 200# Oil Fired
4— 500 H.P. Heine 200 lb. Boilers
Smaller Boilers and Fire Tube Boilers also

1—15000 K.W., G.E. Co., Turbo-Generator Condensing
2—12500 K.W., G.E. Co., Turbo-Generator Condensing
1—5000 K.W., G.E. Co., Turbo-Generator Condensing
3— 4000 K.W., G.E. Co., Turbo-Generator Condensing
2— 2500 K.W., G.E. Co., Turbo-Generator Condensing
2— 2000 K.W., G.E. Co., Turbo-Generator Condensing
1— 2000 K.W., W. E. & M. Co., Turbo-Generator Con.
2— 1000 K.W., G.E. Co., Turbo-Generator Condensing
2— 750 K.W., G.E. Co., Turbo-Generator Condensing
Several 300 KWs. & Smaller Units.

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30—4-71 & 6-71 GM Engines
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Detroit Stoker underfeed side dump 200 H.P. capacity 6 ft. wide by 6 ft. long, motor for 3 ph. 60 cy. 220 volts. Also similar stoker 100 H.P. capacity 55 inches wide by 5 ft. long. Used two years satisfactorily, good condition.
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TRANSFORMERS, LARGE STOCK
D. C. GENERATORS, ALL VOLTAGES
CONTROL EQUIPMENT

ALL SIZES
VOLTAGE AND CYCLES

3 ph. 60 cy. A.C. Motors
3 ph. 25 cy. Motors
125 Volts D. C. Motors
230 Volts D. C. Motors
550 Volts D. C. Motors

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"Certified Rebuilt" ELECTRICAL APPARATUS

M-G SETS

300 KW Gen. Elec. type MPC gen. DC 170 volts 1760 amp. coupled to 450 HP G.E. MPC motor DC 250 V. 1150 RPM (can furnish A.C. drive).
100 KW Gen. Elec. 3 brg. unit, type RC gen. DC 125 v. coupled to 150 HP sq. cage 1-K motor 3-60-2200/4000 V.—1200 RPM.
90 KW Gen. Elec. RC gen. DC 250 V. to 135 HP G.E. sq. cage motor 3/60/220/440/2200 V.
50 KW Cr. Wheeler type CC generator DC 125 V. coupled to 80 HP C-W motor sq. cage 3-60-220/440 V. 1800 RPM.
40 KW Whse. SK gen. DC 250 V. coupled to 75 HP Ideal synch. motor 3-60-220/440 V.—1200 RPM.
35 KW Gen. Elec. DLC gen. DC 250 V. to 50 HP AC motor 3-60-220/440 V.
30 KW Gen. Elec. CD 103 gen. DC 60 v. 500 amp. coupled to 45 HP G.E. KT 532 motor 3-60-220/440 v. 1160 RPM. late style 3 brg. unit.
25 KW Gen. Elec. LC gen. DC 250 V. to 40 HP G.E. KT532 motor 3/60/220/440 V.
Others available—special units built to order.

D. C. MOTORS

H.P.	Mfg.	Type	Volts	Speed
450	Gen. Elec.	MPC	230	1150
75	Whse.	S13	125	475
75	Gen. Elec.	DLC	230	400
50	G.E. Sprague	LC	250	700/2000
50	Whse.	SA	230	450/1350
40	Gen. Elec.	DLC	230	750
40	Roth	S	115	850
40	Whse.	SK	230	900
30	Allis Ch.	E100	230	1800
30	Sprague	LC	230	600/1200
30	Sprague	dynamom	250	800/2000
25	Gen. Elec.	DLC	115	750
25	Roth	elevator	230	725
25	Whse. enclosed	SK	230	600
25	Louis Allis b. b.	NA	230	1800
25	Gen. Elec.	RC32	230	800
20	Imperial int. dty	D37	230	1200
20	Gen. Elec.	RF12	230	400/1200
20	Gen. Elec.	DLC	230	500/1500

OUR 40th ANNIVERSARY—1906 1946

SQUIRREL CAGE MOTORS
3 Phase—60 Cycles—220 or 440 Volts

Qua.	H.P.	Mfr.	Type	Speed
2	150	Gen. Elec.	I-K	900
2	75	Gen. Elec. b.b.	K445	1800
1	75	Allis Ch.	AN	720
2	60	Gen. Elec. b.b.	K444	1800
2	60	Whse. b.b.	CS504	1800
1	60	Allis Ch.	B	600
8	50	Whse. b.b.	CS504	1200
2	50	Gen. Elec. b.b.	K405	1800
2	50	Gen. Elec. vertical	KT	1200
2	40	Allis Ch.	AN	1200
1	40	Gen. Elec.	KT332	1200
1	30	Wagner	19TBP	1800
6	30	Whse. b.b.	CS444	1200
2	30	Century b.b.	SC365	1800
2	30	G.E. TEFC b.b.	KF444	1200
1	30	F. Morse TEFC b.b.	QZC444	1200
2	30	Allis Ch.	AN	1200
3	30	Allis Ch.	AN	900
5	25	Gen. Elec. b.b. hitorq	KTR526	1200
3	25	Whse. New	CS365	1800
1	25	Gen. Elec.	KT322	1200
2	25	Allis Ch.	AN	900
1	25	Whse.	CS	720
2	20	L. Allis splash. b.b.	FX364	1800
4	20	G.E. splash. b.b.	K405	900
4	20	Allis Ch.	AN	900
2	20	Gen. Elec.	I-K	1200
1	20	Ideal	AA	1200
3	20	Gen. Elec.	KT312	1200
2	20	Gen. Elec.	KT501	1800

25 CYCLE MOTORS

H.P.	Mfr.	Type	Speed
450	Whse. 2200 v.	CW sl. rg.	750
300	Whse.	CW sl. rg.	500
150	Whse.	HD sl. rg.	500
150	Gen. Elec. 2200 v.	MT359 sl. rg.	1500
100	Whse.	CCL sq. cg.	500
100	Gen. Elec.	I-Ksq. cg.	500
50	Allis Ch.	ANY sl. rg.	1500

SYNCHRONOUS MOTORS

H.P.	Mfr.	Type	Volts	Speed
750	Allis Ch.		220/440	1200
350	Gen. Elec. 3 brg.	ATB	220/440	600
300	Whse.	ped.	220/440	900
290	Gen. Elec.	ATI	220/440	600
250	Gen. Elec.	ATI	220/440	514
250	Gen. Elec. 1 brg.	ATI	220/440	600
75	Ideal	SM8	220/440	1200
40	Gen. Elec. 8. PF	T8	220/440	900

CENTRIFUGAL PUMPS
14" Foster Wheeler, 5000 gpm @ 45 ft.
10" Weinman, 2500 gpm @ 40 ft.
8" Alberger, 2000 gpm @ 80 ft.
6" Platt, 1000 gpm @ 230 ft.
8" Worthington, 2000 gpm @ 200 ft.

SLIP RING MOTORS
3 Phase—60 Cycles—220 or 440 Volts

Qua.	H.P.	Mfr.	Type	Speed
1	350	Whse. 2200 v.	CW	720
1	300	Burke	EMV	225
1	300	Whse.	HF	400
1	300	Gen. Elec.	MT410	450
1	300	Gen. Elec.	I-P	720
1	250	Gen. Elec.	I-M	600
1	200	Gen. Elec.	I-M	600
1	175	Whse.	MW	450
1	150	Whse. 2200 v.	CW	1200
1	100	Gen. Elec. 2200 v.	I-E13A	1800
1	100	G.E. 2200 v.	I-M	900
1	75	Gen. Elec.	MT537	1800
1	75	G.E. 2200 v.	I-M	900
1	75	G.E. 2200 v.	I-E13	1800
1	65	P & H. b.b. Int.	CA16	900
1	60	Whse. 2200 v.	CW657	1800
2	60	Gen. Elec.	M-505	1200
1	50	Gen. Elec.	MT536	1200
1	50	Gen. Elec.	I-M	600
1	40	Gen. Elec. 2 ph.	MQ536	900
1	40	North'n	HW35A	900
2	40	Gen. Elec.	MT532	1200
1	40	Fair. Morse b.b.	HV	1200
1	40	Whse.	CW	900
2	40	Gen. Elec.	M546	514
2	40	Allis Ch.	ANY	450
1	40	G.E. 550 v.	MT536	900
1	35	Fair. Morse b.b.	HV	1800
1	30	Northwestern b.b.	HW404	1800
2	30	Allis Ch.	ANY	900
2	30	Whse. enclosed	MA	600

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
300	Gen. Elec. 1 brg.	MPC	125/170	1150
75	Whse.	S	125	600
60	Gen. Elec.	DLC	250	450
50	Cr. Wheeler	CC	125	1800
40	Whse.	SK	250	1200
35	Gen. Elec.	DLC	250	900
30	Lincoln b. b. 600 amp.		50	1200
25	Gen. Elec.	DLC	125	900
25	Gen. Elec.	LC	250	900
16	Cr. Wheeler	CCD	125	415

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60 CYCLE A.C. GENERATORS

KVA	Mfr.	Type	Volts	Speed
500	Gen. Elec. 3 brg.	ATB	2300	450
300	Gen. Elec. 3 brg.	ATB	240/480	600
300	Whse.	ped.	240/480	900
300	Elec. Machy. 3 brg.		240/480	720
250	Gen. Elec. 1 brg.	ATB	240/480	600
150	Allis Ch.		2300	900
150	Allis Ch. 25 cycle		240/480	500
100	Cr. Wheeler	ped.	240/480	600

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2—1000KW 250V Westgh complete

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One 250 K.V.A. and one 300 K.V.A. Crocker Wheeler Generators direct connected to Skinner Tandem compound engines—480 volts—3 phase 60 cycle, switchboard, instruments, piping.

One 300 K.W. General Electric Generator, 2300 v., 3 ph., 60 cy., direct connected to Curtis Steam Turbine, 175 lbs. pres.—3600 R.P.M. with 15 K.W. G.E. direct connected exciter.

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Induction Type—220 V.—2 Ph.—60 Cy.

1—5 H.P. Burke—Type EB 5—1130 RPM.
1—5 H.P. Burke—Type EB 75—900 R.P.M.
1—7½ H.P. R&M—TYPE K—850 R.P.M.
1—10 H.P. Burke—Type EM 1.2—900 R.P.M.
2—20 H.P. Burke—Type EM 3—1200 R.P.M.
1—20 H.P. Crocker Wheeler—1170 R.P.M.
1—35 H.P. Burke—Type EM—4.5—900 R.P.M.
1—50 H.P. Burke—Type EM—4.5—1200 R.P.M.
1—150 H.P. West—Type CW—1765 R.P.M.
1—7½ H.P. totally enclosed—fan cooled—1200 R.P.M.

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One Quimby 4 stage Centrifugal pump direct connected to 75 H.P. G.E. motor—220 volts—3 phase, 60 cycle, 1750 R.P.M.—500 G.P.M. 150 lbs. pressure.

One American Well 2 stage Centrifugal pump direct connected to 30 H.P. G.E. motor, 220 v., 3 ph., 60 cy., 1750 R.P.M. 200 ft. head complete with magnetic starter and safety switch.

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3—American Well Works; capacities 85, 165 and 200 g.p.m. with 10, 15 and 20 H.P. Motors; Current 220 volts, 3 phase, 60 cycle.

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1—Warren Duplex—Size 10" x 7" x 12" Brass Lined & Fitted—Stainless Piston Rods
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One 444 H.P. Union Iron Works, water tube steam boiler 200 lb. working pressure, pulverized coal or oil fired.

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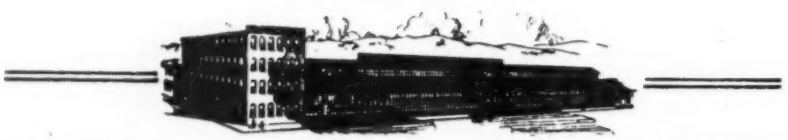

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1—2000 KW General Electric Turbo-Generator, 2500 KVA, 6600 Volts, 219 Amps, 3600 RPM, Type ATB, Form HT, direct-connected exciter with Elliott Jet Type Condenser, Serial No. 4219008.
1—1250 KW General Electric Turbo-Generator, Type ATB, Form HT, 3600 RPM, direct-connected exciter, Wheeler Jet Condenser.
1—2750 KW General Electric Turbo-Generator. Steam pressure 150 lb., A.C. Generator, Type AQB, Class 4—Form HT, Speed 1800 RPM, Volts 2300, Amps 598. W.M. Kellogg Co. Twin Bulkley Injector Condenser.
1—2000 KW General Electric Turbo-Generator, 180 lb. pressure, 3600 RPM Generator, Type ATB, 600 Volt AC, 2403 Amp, with Westinghouse-Le Blanc Jet Condenser.
1—750 KW General Electric Turbo-Generator, 150 lb. Pressure, type ATB, Form HT, 600 Volts, Speed 3600 RPM, with Westinghouse-LeBlanc Jet Condenser.

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2—100 HP, General Electric, type 1-17, from K, 3-60-440V, 350 RPM

1—100 HP Westinghouse, type CCL, 3 ph. 60 cy., 2200 V. 1750, Squirrel Cage

1—100 HP Allis-Chalmers, type ANY, 3 ph. 60 cy., 220V, 580 RPM slip ring

1—100 HP General Electric 3 ph. 60 cy. 4000V. 720 RPM syn., type TS with direct connected exciter

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3—100 HP, General Electric, 3-60-440V, 450 RPM sq. cage

4—75 HP G. E. 3-60-2300V, 400 RPM, type I, sq. cage

1—75 HP General Electric, type KT, frame 562, 3-60-440V, 450 RPM

1—75 HP Fairbanks-Morse, type H, frame 105C, 3 ph, 60 cy, 550V, 900 RPM Squirrel Cage

1—75 HP Lincoln, type 1Q, 3 ph. 60 cy. 3 phase, 440V, 600 RPM Squirrel Cage

2—75 HP Fairbanks-Morse, 3 phase, 60 cycle, 2200 volt, 1800 RPM, slip ring motors

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1—50 HP General Electric 3-60-220V, 1150 RPM, type I, slip ring

1—50 HP Triumph 3-60-440V, type C12 1150 RPM, slip ring, rotor & stator rewound

1—50 HP General Electric, 3-60-440V, 900 RPM, type I-M, slip ring

1—50 HP General Electric, 3-60-440V, 720 RPM, type IK, Sq. Cage

2—50 HP Allis-Chalmers, 3-60-440V, 720 RPM, slip ring

1—50 HP General Electric, 3-60-440V, 690 RPM, MT 546, slip ring

1—50 HP Wagner 3-60-440V, 495 RPM, type BM, Sq. Cage

1—50 HP Allis-Chalmers, 3-60-440V, 490 RPM, Sq. Cage

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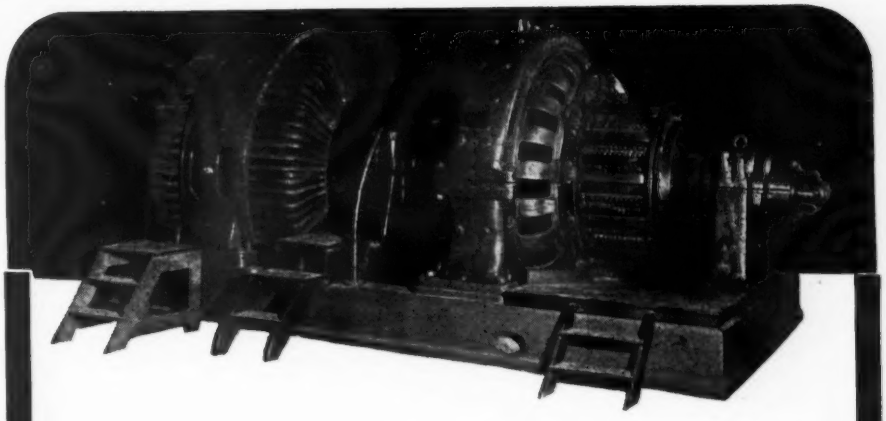

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400	GE	600	60 cy. syn.
400	GE	1200	60 cy. syn.
300	West	720	60 cy. syn.
200	GE	1200	60 cy. syn.
150	West	850	60 cy. sq. cg.
150	Al.—Ch.	500	25 cy. rot.
125	Hertner	1200	60 cy. syn.
100	GE	1200	3 wire 60 cy.
100	GE	750	25 cy. rot.
75	GE	1200	60 cy. syn.
50	West	1200	60 cy. sq. cg.
40	GE	1800	60 cy. syn.
25	GE	1800	60 cy. sq. cg.
15	GE	1200	60 cy. sq. cg.
15	GE	750	25 cy. sq. cg.
10	West	900	60 cy. sq. cg.
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25-Ton Whiting 82' Span
25-Ton Niles 46' Span
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6— 200 KVA 13800—230/460 V.
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2—5000 KW Westinghouse 3600 RPM 3/60/2300 volts Condenser, all auxiliaries.

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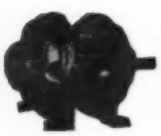

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1—800 A Conduit E4 600 V. 3 PST Handle. Trip Coils and Currents.

1—1200 A. GE FK 132 A 3 PST 7500. Handle with Trip Coils and Current Transformer.

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1—3000 A GE FK 25 Oil Breaker 3 PST 600 V. Solenoid operated with currents.

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2	100	G. E.	IK	1800
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Slip Ring—220/440 V. 60 cy. 3 ph.				
1	40	West.	CW	720
1	50	G. E.	I-M	900
1	60	G. E.	I-M	900
1	75	West.	CW	900
1	250	West.	CW	1200
D. C. Variable Speed 230 V.				
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1	25	West.	SK	400/1200
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1	50	G. E.	CD	400/1600

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2—360 HP 200# 100° stokers 1924 (250%.
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1—150 HP 100# Comb. Engrg. Economic (1940).
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1—150 HP 150#—one 250 HP 130#—one 400 HP 128#.

HRT

1—80 HP 125# Stanwood (1936 used 60 days). ...
2—80 HP 175#—one 200 HP 160#—three 150 HP 150#.

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200 KW 60/3/600 80 to 200/15P 0-15#BP (1927)
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500 KW 60/3/2300 200/15P 20#BP (1929)
1000 KW 60/3/2300 400/15P 50#BP (1928)

G. E.

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1000 KW 60/3/480 200/SP 15#BP (1925)

TERRY

500 KW 60/3/480 185#/SP 15#BP (1941)

COND. WEMCO

300 KW 60/3/240 200/SP Surf (1925). Rebuilt 1942)
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5000 KW 60/3/2300 200/SP Jet (1920)

G. E.

300 KW 60/3/480 200/SP Jet (1923)
500 KW 60/3/2300 200/SP Surf (1919—6 Mo. Service)
1250 KW 60/3/2300 200/SP Jet
One 1920 and one 1924

ALLIS

1250 KW 60/3/480 200/SP Jet (1918—Two)
4000 KW 60/3/2300 350/SP Jet (1920)
300 KW 60/2/2300 200/SP Jet (1926)
500 KW 60/2/2300 200/SP Jet (1921)
1250 KW 60/3/2300 200/SP Surf (1924)

PLANT 1932

Boilers 1400 HP total B.W., stokers 1932
NC turbos 800 KW total 6/3/2300 1932
Cond. turbo 1000 KW 60/3/2300 1914
All Auxiliaries

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DIESEL: One 2500 KW, one 1000 KW modern FREQUES 5000-10,000 KVA 60 cyc. true.
Turbo cond. two 1000 KW 450#
NC two 1000 KW 450#

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USED, OPERATING CONDITION

2—62½ K.W. Chuse 4 valve, balanced slide valve, steam engines 125# pressure 5# back. Direct connected to Westinghouse D.C. Generators, 3 wire 115/230 volts.
1—37½ K.W. Chuse balanced single valve, steam engine 125# pressure 5# back. Direct connected to Westinghouse D.C. Generator 3 wire 115/230 volts.

Complete with separators, balancing coils and gen. panels (few switches and instruments missing) prices to sell. Write

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"Sea Power"

This is a complete modern steam electric generating station with a water and fuel rate comparable to modern fixed electric stations. The plant is equipped with a sea going hull suitable for towing from one location to another.

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Two Babcock and Wilcox boilers with steam capacity of 170,000 pounds/hour, each at an operating pressure of 825 pounds/sq. inch and operating temperature of 900 degrees F. Equipped for burning fuel oil or natural gas.

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1—3125 Kva. G.E. Turbo 230 V. 60 Cy. 3 ph.
100 KW. 550 V. 3600 Rev. 60 CY. 3 PH. turbo with exciter.
1500 CFM 2 STAGE AIR COMP. 275 HP. 60 CY. 2200 V. Syn. Motor Dr.
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1500 and 2500 HP. 60 CY. A.C. Motors, 435 and 257 Rev.

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Turbine Generator, G.E., A.C. generator, 2300 V.—150 KW 471 Amp., Type ATB-2-1875-3600, Form T, Direct connected to G.E. Curtis 3 stage turbine—1500 KW—3600 RPM, 200 lb. steam.

Complete with pump and fittings, original cost $75,000.00. *Can be bought cheap.*

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1937 and 1943

One—655 HP 200# installed 1943 Type A—3 drum—Union Iron Works 98' Wemco Stoker—Water Walls 35000# HR Operated 8 months—NB 2399.

and

Two—329 HP 200# installed 1937 Type L—3 drum—Low head—Union Iron Works 68' Wemco Stokers 23,000#/HR each. Operated thru 1944—NB 1700 and 1794.

Steel Bldg. 36' W x 46' L x 30' H to trusses
Two—900 T and One 600 T Coal Hoppers
Two—150' Stacks—Accessories complete and modern
Located—Raleigh County, W. Va.

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300 Kw GE, 500 Kw Wemco (type EHNC), 60/3/2400 v Built 1932. Located W. Va.

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2—600 H.P. Springfield Crossdrum Boilers Complete with Harrington Stokers

Including steel structure, soot blowers, superheaters, forced draft fan and vertical reciprocating steam engine 8 x 8. Approved for 200# working pressure. Completely dismantled ready for immediate shipment.

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Galesburg, Illinois

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1—1250 KVA WH. Turbine, Condenser and Auxilliaries
1—75 KW Sycmotor Generator Set
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2—Worthington Steam Pumps
All machinery can be seen in operation.
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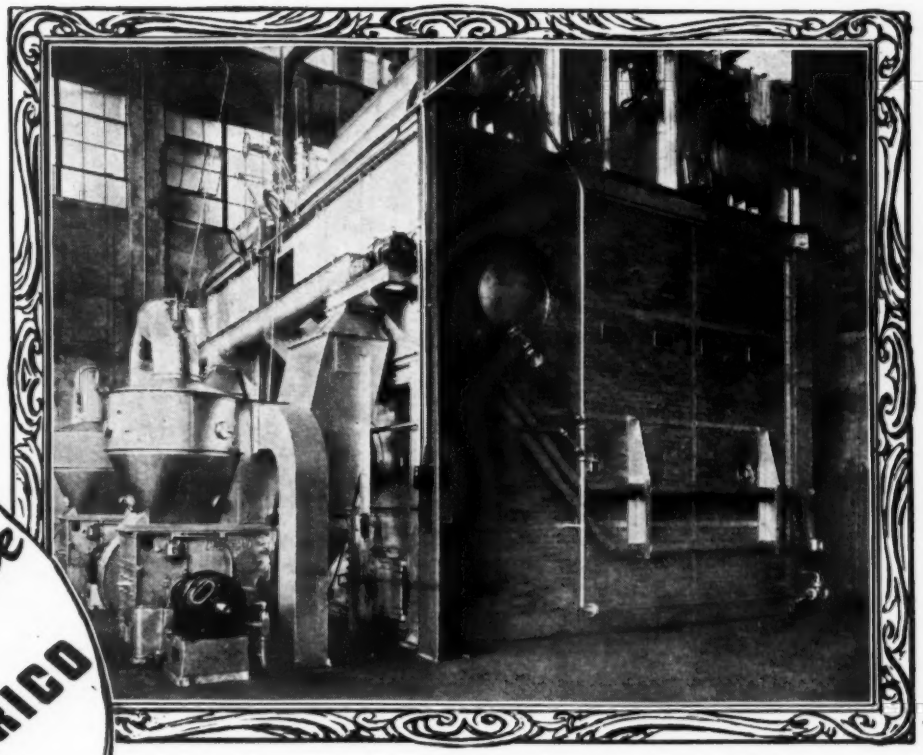
5344 Germantown Ave., Phila., 44, Pa.

NEW "SEARCHLIGHT" ADVERTISEMENT

received by February 13th, will appear in the March issue, subject to limitations of space available.

Address copy to the Departmental Staff

Power
330 West 42d St., New York 18, N. Y.

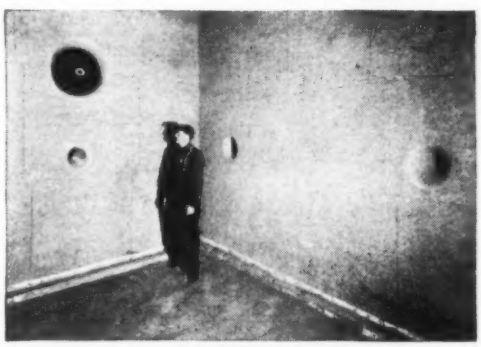


Two 350 h.p. union boilers equipped with Strong-Scott pulverizers at Nestles Milk Products, Inc., Greenville, Ohio. These handsome settings erected by Plibrico are provided with Plibrico sectionally-supported, air-cooled walls and Beco-Turner baffles. Note air ports in setting walls for admission of cooling air.

IN our hands, setting boilers is an art which, we modestly admit, has reached a high degree of perfection. A Plibrico setting designed by our engineering department and erected by our boiler setting department is "a thing of beauty and a joy forever."

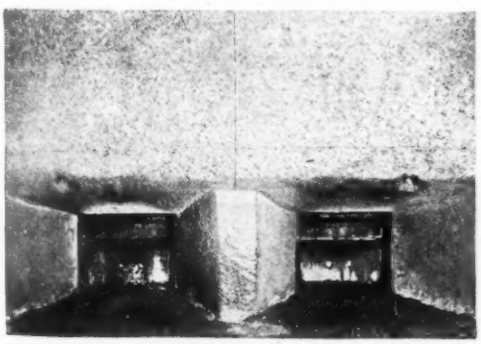
"Forever" is a long time, but the monolithic Plibrico linings which are a feature of all Plibrico boiler settings last a long time, especially if Plibrico sectionally-supported, air-cooled construction is employed to meet severe combustion conditions as in the masterpiece pictured above.

Plibrico Jointless Firebrick is as suitable for repairs, relining, suspended arches, etc., as for complete settings. Let your local Plibrico sales and service engineer quote on your refractory requirements including installation service if required. Write for our big catalog specifying H.R.T. or water tube boiler edition.



for PULVERIZED COAL

Plibrico air-cooled lining in connection with typical boiler burning pulverized coal. Plibrico sectionally-supported, air-cooled construction is suitable for large units operating under severe conditions.



for OTHER EQUIPMENT

Plibrico lining in connection with spreader type stoker showing adaptability of Plibrico construction to special shapes which makes it ideal for all types of stokers, oil burners, and gas burners.

PLIBRICO JOINTLESS FIREBRICK CO.
1818 North Kingsbury Street (Dept. B.), Chicago 14, Illinois

PLIBRICO *Boiler* SETTINGS

ADVERTISERS' INDEX

Where an * appears after a name the advertisement does not appear in this issue, but appeared in preceding issues.

Adams Co., R. P. 259
Airetool Mfg. Co. 316
Air-Maze Corp. 282
Air Preheater Corp. *
Air Reduction Sales Corp. 213
Air Transport Ass'n. of America for Railway Express Agency 158
Ajax Flexible Coupling Co. 186
Alco Products Div. 46-47
Aldrich Pump Co. 224
Alken-Murray Corp. *
Allen-Sherman-Hoff Co. Second Cover
Allis-Chalmers Mfg. Co. 18, 35, 49, 54-55, 155, 163
Allpax Co. 332
American Brass Co. 125
American Chain & Cable Co. 268
American Chimney Corp. 330
American Coal Burner Co. 320
American District Steam Co. *
American Engineering Co. 34, 205
American Flexible Coupling Co. *
American Locomotive Co. 46-47
American Manganese Steel Div. 166
American Metal Hose Branch *
American Pulverizer Co. 233
Ames Iron Works *
Anaconda Wire & Cable Co. 177
Anchor Packing Co. 171
Anderson Co., V. D. 149
Ansul Chemical Co., Dugas Div. *
Arkansas Fuel Oil Co. 325
Armor-Clad Co. 198
Armstrong Cork Co. 277
Armstrong Machine Works 201
Asbestos Textile & Packing Div., Raybestos Manhattan, Inc. *
Atlas Luminite Cement Co. 222
Atlas Valve Co. 208
Automatic Control Co. *

Babbitt Steam Specialty Co. 216
Babcock & Wilcox Co. 4-5
Babcock & Wilcox Tube Co. *
Badger & Sons Co., E. B. *
Bailey Meter Co. 14-15
Baldwin-Hill Co. *
Baldwin Locomotive Works *
Bartlett & Snow Co., C. O. *
Bates Co., Walter 306
Beaumont-Birch Co. 174
Belmont Packing & Rubber Co. *
Bernitz Furnace Appliance Co. *
Betz Co., W. H. & L. D. *
Biddle Co., James G. *
Bird-Archer Co. 320
Bird-White Co. 320
Blaw-Knox Co. 275
Boiler Tube Co. of America 310
Bonney Forge & Tool Works 287
Boston Woven Hose & Rubber Co. 231
Botfield Refractories Co. 212
Bowser, Inc. *
Brad Foote Gear Works *
Brickseal Refractory Co. *
Bridgeport Brass Co. *
Briggs Clarifier Co. *
Brooke Engrg. Co., Inc. 204
Bros Broiler & Mfg. Co. *
Brownell Co. 314
Brown Instrument Co. 197
Brunt Equipment Co. 330
Buell Engrg. Co. *
Buffalo Forge Co. *
Buffalo Pumps, Inc. 286
BullDog Electric Products Co. 252
Burgess-Manning Co. 187
Burke Electric Co. 294
Burlington Instrument Co. *
Bussman Mfg. Co. *
Byers Co., A. M. 62

Cabot, Inc., Samuel 212
Canton Stoker Corp. *
Carborundum Co. 312
Cardox Corp. *
Carey Mfg. Co., Philip 232
Carrier Corp. *
Cash Co., A. W. 248
Cash Valve Mfg. Corp., A. W. 310
Chapman Valve Mfg. Co. 145
Chase Brass & Copper Co. *
Chicago Metal Hose Corp. 164
Chicago Pneumatic Tool Co. *
Cities Service Oil Co. 323
Clarage Fan Co. 256
Clark Mfg. Co. 309
Cleaver-Brooks Co. *
Climax Engrg. Co. *
Cochrane Corp. *
Coffin Jr., Co., J. S. 292
Combustion Control Corp. *
Combustion Engrg. Co. 16-17
Connery Construction Co. 170
Copper Bessemer Corp. *
Coppus Engrg. Corp. 223
Corning Glass Works 202
Crane Co. 127
Crocker Wheeler Electric Mfg. Co. *
Cryer Trap & Valve Co. 174
Cuno Engrg. Co. 147
Cutler-Hammer, Inc. Back Cover
Cyclotherm Corp. 262

Dampney Co. of America 159
Dart Mfg. Co., E. M. 162
Davis Engrg. Corp. *
Davis Regulator Co. 176
Dayton Rubber Mfg. Co. *
Dearborn Chemical Co. 209
Defender Instrument & Regulator Co. *
De Laval Separator Co. 267
De Laval Steam Turbine Co. 58, 206
Deming Co. 242
Detroit Stoker Co. 240
Diamond Power Specialty Corp. 8-9
Dixon Crucible Co., Joseph *
Dodge Mfg' Corp. 270
Dollinger Corp. 264
Dominion Chemical Co. 318
Dowell, Inc. 263
Drew & Co., Inc., E. F. 308
Du Pont de Nemours Co., E. I. *
Dura-Tred Co. *
Dutton Co., C. H. *

Eagle-Picher Sales Co. 288
Edge Moor Iron Works *
Edward Valves, Inc. 121
Electric Fish Screen Co. *
Electric Machinery Mfg. Co. 285
Electric Storage Battery Co. 157
Electro Metallurgical Co. 253
Elgin Softener Corp. 299
Elliott Co. 6-7, 226
Engineer Co. *
Everlasting Valve Mfg. Co. 320

Faber Engrg. Co., Inc. *
Fairbanks Co. *
Fairbanks, Morse & Co. 139
Fairfield Engrg. Co. *
Fairmont Coal Bureau *
Falk Corp. 44-45
Farris Engrg. Co. 290
Felt Products Mfg. Co. 271
Fischer & Porter Co. *
Fisher Governor Co. 172
Flexitallic Gasket Co. 234
Flexo Supply Co. *
Flexrock Co. 306
Foster Engrg. Co. *
Foster Wheeler Corp. 10-11
Foxboro Co. 228
France Packing Co. *
Frick Co. 190
Fuller Co. 154
Fulton Sylphon Co. 251
Fyr-Feeder Spreader Stoker 320

Gardner-Denver Co. 189
Garlock Packing Co. 48
General Coal Co. 180
General Electric Co. 12-13, 50, 173, 203
Gifford Wood Co. *
Gilmer Co., L. H., Div., U. S. Rubber Co. *
Globe Steel Tubes Co. 296
Goetze Gasket & Packing Co. 181
Golden-Anderson Valve Specialty Co. 167
Goodall Rubber Co. *
Goodyear Tire & Rubber Co. 41
Goulds Pumps, Inc. *
Graton & Knight Co. *
Graver Tank & Mfg. Co. *
Graybar Electric Co. 269
Green Fuel Economizer Co. *
Greene, Tweed & Co. *
Grinnell Co. Third Cover
Griscom-Russell Co. 123
Grove Regulator Co. *
Gulf Oil Corp. 235
Gulf Refining Co. 235

Hagan Corp. 28-29
Hahn Equip. Corp. 324
Hall Laboratories 52-53
Hammel-Dahl Co. *
Haynes Stellite Co. *
Hays Corp. 165
Hays Institute of Combustion 218
Heacon, Inc. 238
Helicoid Gage Div., American Chain & Cable Co. 150
Henszey Co. 184
Hercules Float Works 216
Hewitt Rubber Corp. 185, 265
Hoffman Combustion Engrg. Co. 32-33
Hoffman Specialty Co. *
Homestead Valve & Mfg. Co. *
Honan-Crane Corp. 138
Hoppes Mfg. Co. 322
Huyette Co., Paul B. *

Imperial Brass Mfg. Co. *
Infilco, Inc. *
Ingersoll-Rand Co. 207
International Cementers, Inc. 268
International Nickel Co. 51, 195
Iron Fireman Mfg. Co. 20-21

Jefferson Union Co. 170
Jeffrey Mfg. Co. 225
Jenkins Bros. 132-133
Johns-Manville, Inc. 137
Johnson Service Co. *
Jones & Laughlin Steel Corp. *
Jones Foundry & Machine Co., W. A. 304

Kano Laboratories 324
Keasbey & Mattison Co. 161
Kellogg Co., M. W. 219
Kennedy Valve Mfg. Co. 298
Kennedy-Van Saun Mfg. & Engrg. Corp. 22-23
Kewanee Boiler Corp. 202
Kidde Co., Walter *
Kieley & Mueller Co. 153

Laminated Shim Co. *
Leavitt Machine Co. 304
Leeds & Northrup Co. *
Leslie Co. 218
Lincoln Electric Co. *
Linde Air Products Co. *
Link-Belt Co. 3
Liquidometer Corp. 306
Locke Regulator Co. *
Lubriplate Div., Fiske Bros. Refining Co. *
Ludlow Valve Mfg. Co. *
Lummus Co. 258
Lunkenheimer Co. 36-37

MacWhyte Co. 182

Magnaflux Corp. *
Manhattan Rubber Mfg. Div., Raybestos Inc. *
Manheim Mfg. & Belting Co. 193
Manzel Brothers Co. 332
Marion Machine Foundry & Supply Co. 310
Mark & Co., Clayton *
Marley Co. 319
Marsh Corp., James P. *
Mason-Neilan Regulator Co. *
Maxim Silencer Co. 129
McAlear Mfg. Co. 183
McGraw-Hill Book Co. 302, 316
Mercoid Corp. 198
Midwest Piping & Supply Co. 175
Minneapolis-Honeywell Regulator Co. *
Mitchell Co., W. K. *
Monsanto Chemical Co. *
Murray Iron Works Co. 168

National Airoil Burner Co. 196
National Aluminate Corp. 131
National Electric Products Corp. 43
National Supply Co. 257
National Tube Co. *
National Valve & Mfg. Co. 220
Nazareth Steel Fabricators, Inc. 324
Niagara Blower Co. *
Nicholson Co., W. H. 194
Nordberg Mfg. Co. 280
Northern Equipment Co. 135
Norton Co. *
Nugent Co., W. W. 314
Nutmeg Chemical Co. 188

Oakite Products, Inc. 311
Ohio Injector Co. 296
Orr & Sembower, Inc. 192
Otis Elevator Co. 266
Owens-Corning Fiberglas 303

Pacific Pumps, Inc. *
Parker Appliance Co. 273
Peabody Engrg. Corp. *
Peerless Pump Division 318
Pennsylvania Flexible Metallic Tubing Co. 284
Pennsylvania Pump & Compressor Co. 212
Permutit Co. *
Persson Co., T. G. 194
Philadelphia Gear Works 281
Photoswitch, Inc. *
Pipe Fabrication Institute 289
Pittsburgh Piping & Equipment Co. 261
Plant Rubber & Asbestos Works *
Plibrico Jointless Firebrick Co. 357
Powell Co., Wm. 56-57
Powers Regulator Co. 188, 330
Prat-Daniel Corp. *
Preferred Utilities Mfg. Corp. 216
Pritchard & Co., J. F. 140
Proportioneers, Inc. 300

Q-P Mfg. Co. 254
Quaker Rubber Corp. *

Reading Pratt & Cady Div. 274
Reeves Pulley Co. 215
Reliance Electric & Engrg. Co. 283
Reliance Gauge Column Co. 38-39
Republic Flow Meters Co. 24-25
Republic Rubber Div. (Lee Tire & Rubber Corp.) *
Republic Steel Corp. 249
Research Corp. 40
Resinous Products & Chemical Co. 255
Revere Copper & Brass, Inc. 115
Rhoads & Sons Co., J. E. *
Richardson Scale Co. 160
Ric-Wil Co. *
Ridge Tool Co. 322
Riley Stoker Corp. 96-97
Ripley Co. *
Robins Conveyors, Inc. 185
Rockbestos Products, Inc. 278
Roebling's Sons Co., John A. 237
Roper Corp., Geo. D. 302
Ross Heater & Mfg. Co. *
Roto Div. of Elliott Co. 241
R-S Products Corp. *
Ruberoid Co. *

Sarco Co. 276
Sauerman Bros. Co. 182
Saverite Engrg. Co. 206
Scherr Co., George *
Schramm, Inc. 142
Schutte & Koerting Co. 211
Scovill Mfg. Co. 247
Shaw Co., B. F. 179
Sier-Bath Gear Co. 315
Sinclair Refining Co. 42
Sivyer Steel Casting Co. 169
Skinner Engine Co. 230

SKF Industries *
Sloan Valve Co. 239
Smith Refractories, Sanford C. 330
Smooth-On Mfg. Co. 331
Socony Vacuum Oil Co. 143
Springfield Boiler Co. 19
Square D Co. 279
Squires Co., C. E. 314
Standard Oil Co. of Calif. 272
Standard Oil Co. of Ind. 151-152
Standard Pressed Steel Co. 214
Star Fuse Co. *
Steel & Tubes Div. 249
Stephens-Adamson Mfg. Co. 321
Sterling Engrg. & Mfg. Corp. 214
Stickle Steam Specialties Co. 156
Stock Engrg. Co. 178
Strong Carlisle & Hammond Co. 260
Struthers Wells Corp. *
Sturtevant Co., B. F. *
Sturtevant Mill Co. 200
Sullivan Machinery Co. 307
Sun Oil Co. 119
Superior Engine Div. 257
Swartwout Co. 360
Syntron Co. 322

Taylor Co., W. A. *
Taylor Forge & Pipe Works 291
Taylor Instrument Co's. 245
Templeton Mfg. Co. 214
Terry Steam Turbine Co. 191
Texas Co. 30-31
Thermix Engrg. Co. 238
Thermoid Rubber Div. 295
Tide Water Associated Oil Co. 305
Timken Roller Bearing Co. 217
Todd Shipyards Corp. (Combustion Equip. Div.) *
Toledo Pipe Threading Machine Co. *
Tripp Metallic Packing Co. 330
Troy Engine & Machine Co. 250
Tube Turns, Inc. 141

Union Asbestos & Rubber Co. *
Union Carbide & Carbon Corp. 253
Union Chain & Mfg. Co. 246
Union Iron Works *
U. S. Gauge Co. 298
U. S. Gasket Co. *

Viking Pump Co. 190
Vogt Machine Co., Henry 244

Waite Construction Co. *
Wallace & Tiernan Products, Inc. 146
Walworth Co. 301
Warren Steam Pump Co. 313
Watson-Stillman Co. 297
Webster & Co., Warren 248
Western Chemical Co. 210
Westinghouse Electric Corp. 60-61, 229
Weston Electrical Instrument Corp. *
Wheeler Mfg. Co., C. H. 206
Where To Buy 330
Whitlock Mfg. Co. 332
Wickes Boiler Co. 227
Wiedecke Co., Gustav *
Wilkening Mfg. Co. *
Williams Gauge Co. 144
Wilson, Inc., Thomas C. 221
Wing Mfg. Co., L. J. *
Wood's Sons Co., T. B. *
Worthington Pump & Machinery Corp. *
Wrigley Jr., Co., Wm. 331

Xzit Sales Co. 214

Yarnall-Waring Co. 26-27, 117, 148
Yeomans Bros. Co. *
Youngstown Miller Co., Subs. Walter Kidde Co. *
Youngstown Sheet & Tube Co. 199

Zallea Brothers & Johnson 317
Zink Co., John A. *

PROFESSIONAL SERVICES 330

SEARCHLIGHT SECTION

(Classified Advertising)

CLASSIFICATION	PAGE
EMPLOYMENT SERVICES	334
POSITIONS VACANT	333
POSITIONS WANTED	334
SELLING OPPORTUNITIES	334
WANTED TO PURCHASE	334
USED EQUIPMENT	334-356
Arnessen Electric Co	354
American Air Compressor Corp	349
Atlantic Transformer Co	347
Belyea Co., Inc.	337
Berger Bros. Electric Motors, Inc.	353
Birch Manufacturing Co	354
Benjamin's For Motors	356
Brew, Woltman & Co., Inc	347
Chicago Electric Co	346
Cohen & Co., Lou	350
Columbia City Light Dept	356
Crawbuck Co., John D	348
Davis Co., J. F.	353
Douglas, Stephen A.	353
Duquesne Electric & Mfg. Co	344
Economy Co., Inc.	352
Electric Apparatus Repair Co	349
Electric Equipment Co	351
Electric Generator & Motor Co	353
Electric Motor & Machinery Co	342
Electric Service Co., Inc.	352
Electro-Tech Equipment Co	352
Ellis Co., A. Lee	347
Emsco Equipment Co	350
Erie Electric Co., Inc.	344
Fletcher Sales Co	354
General Power Plant Corp	352
Glow-Electric Co	350
Greenspon's Son Pipe Corp., Jos	348
H. & P. Machinery Co	345
Hall & Co., Stephen	348
Hay & Co., F. W.	352
Hemphill & Co., Inc., J. L.	335
Howe Brothers	352
Huntington Hotel Co	355
Industrial Trading Co	350
International Power Machy Co	336
Iron Steel Products Inc	354
Jay, Paul	334
Johnson & Assoc., Howard Blaine	345
Keystone Power Plant Eq. Co	349
Kiemle Co., Fred W	348
Kirk Co., Wallace E.	347
Land & Co., L. J.	338
Lansburgh & Brothers	348
Locke Co., C. B.	355
Manheim Laundry Co	356
Metropolitan Plumbing Supply Co., Inc.	352, 354
Midwest Mfg. Co	356
Miller & Holmes Inc.	353
Mississippi Valley Equipment Co	350
Motor Power Co. of N. Y. Inc	355
Penn Machinery Co	350
Power Equipment Co	334, 354
Power Plant Equipment Co., Inc.	345
Rearick, Charles B.	348
Reconstruction Finance Corp	343, 355
Republic Textile Equipment Co	350
Rives, W. L.	356
Ross Power Eq. Co	356
Schoonmaker, A. G.	345, 353
Schoonmaker, Robert	339, 341, 352
Stanhope, Inc., R. C	348
Stark Electric Co	353
Stewart & Co., Inc., Paul	352, 355, 356
Superior Equipment Co	349
Tennessee Eastman Corp	354
Thompson Parker Co., J.	354
Utilities Electric Machinery Co	340
Wagner Co., Arthur	349
Wente Electric Co	351
Wilms, Weaver & Co	345, 346
Wurth Electric Motor Co	353

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Meets your most critical demands . . . assures constantly accurate regulation

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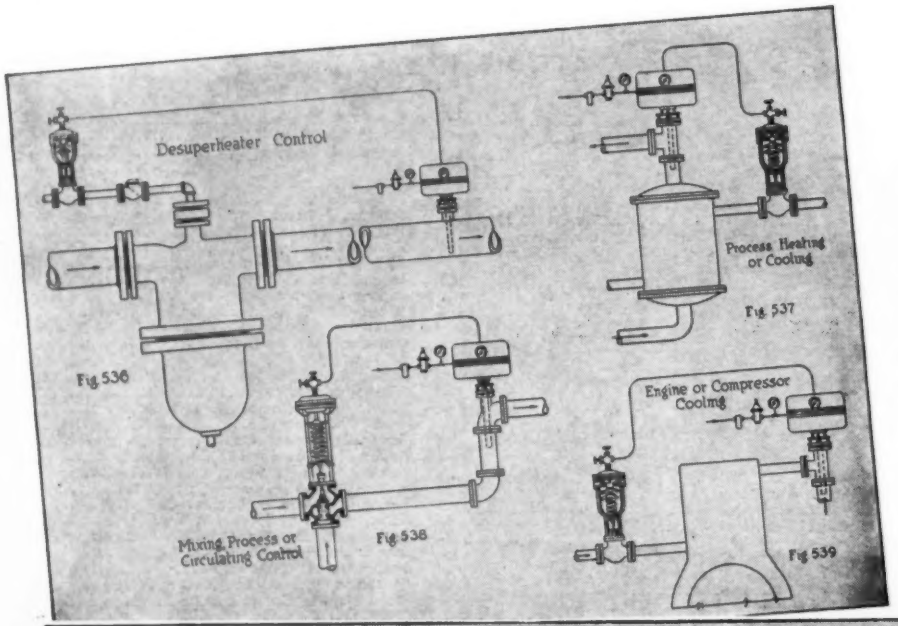

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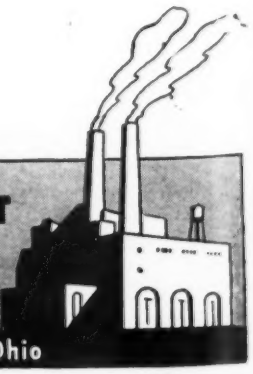

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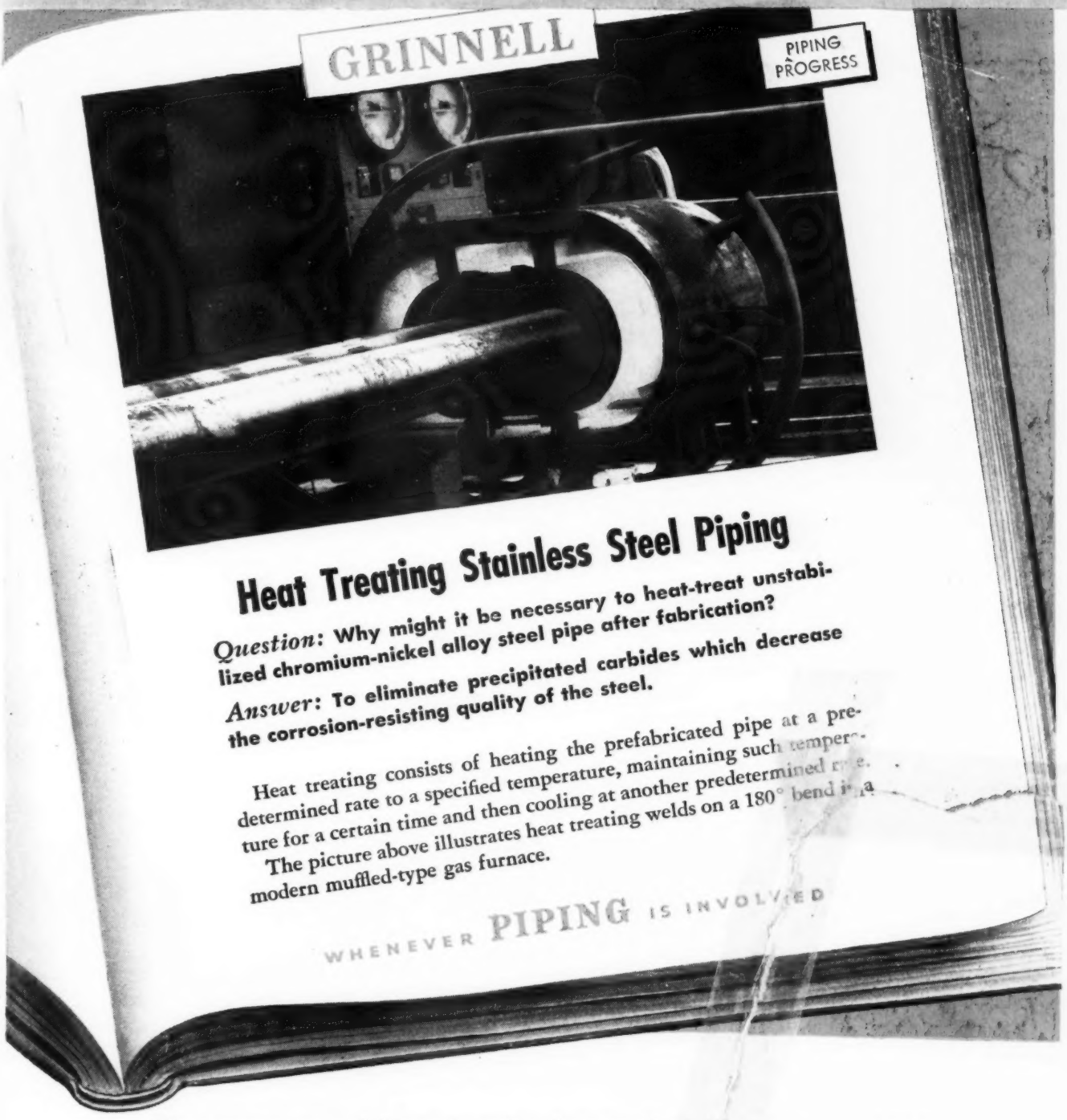

Heat Treating Stainless Steel Piping

Question: **Why might it be necessary to heat-treat unstabilized chromium-nickel alloy steel pipe after fabrication?**

Answer: **To eliminate precipitated carbides which decrease the corrosion-resisting quality of the steel.**

Heat treating consists of heating the prefabricated pipe at a predetermined rate to a specified temperature, maintaining such temperature for a certain time and then cooling at another predetermined rate. The picture above illustrates heat treating welds on a 180° bend in a modern muffled-type gas furnace.

WHENEVER PIPING IS INVOLVED

There are many types of alloy steel – each with its own particular properties and characteristics, such as reactions under the heat of welding and bending. Grinnell engineers are familiar with these reactions and have developed closely controlled and metallurgically supervised procedures for fabricating alloy piping to obtain the full advantages of alloy steels for corrosion resistance and for high pressure and high temperature applications.

Whatever the piping requirements, Grinnell has the specialized engineering knowledge and experience to handle the job – from first plan to actual operation. Grinnell can supply everything from a tiny tube fitting to a complete power plant installation.

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Cutler-Hammer Motor Control in all generally used types and sizes is carried in stock and proudly recommended by recognized electrical wholesalers in every community.

Almost *all* of America's manufacturing operations today depend on the smooth performance of electric motors. That is why experienced factory managers make the selection of dependable motor control one of their definite responsibilities. They know the improper operation or failure of *any* motor, large or small, can cause production losses far too costly to be chanced by the careless purchase of motor control. That is why it is common practice in thousands of factories to specify motor control not only by type but by name . . . Cutler-Hammer . . . for assured dependability.

The small Cutler-Hammer manually operated starter (Bulletin 9115) shown here clearly demonstrates the engineering leadership which has made Cutler-Hammer the choice of experts everywhere. This unit, though barely larger than a man's hand, offers such famous Cutler-Hammer features as dust-safe vertical contacts and eutectic alloy overload protection. It is simple, compact, and rugged. It is easily installed, easily wired, easily inspected and completely dependable in performance. It is obvious proof that even the smallest industrial motors can have the best in control at no extra cost. CUTLER-HAMMER, Inc., 1358 St. Paul Avenue, Milwaukee 1, Wisconsin. Associate: Canadian Cutler-Hammer, Ltd., Toronto.

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